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SELF-EXCITER ALTERNATORS.

The inability of the alternator to excite its own field directly has been somewhat of a drawback. In particular, for small plants the necessity of buying a somewhat expensive auxiliary machine adds not a little to the cost of the electrical equipment. The energy required is small, and, under almost all conditions of operation, could be furnished by the alternator itself without being felt. All that is necessary is that the alternating current should be converted into direct current, or merely a uni-directional pulsating current, in a satisfactory manner. It was in an attempt to do this that the first self-exciting alternators were constructed. These were provided with a commutator and sometimes with a special winding on the armature in which the exciting current was generated. Sometimes merely part of the alternating current was rectified and sent to the field coils. But this pretty solution was not satisfactory in practice. It was found difficult to rectify the alternating current without bad sparking, and the fact that the same magnetic field was employed in generating the exciting current and the main current gave rise to poor regulation, for the reactions of the armature not only decreased the strength of the magnetic field, but in so doing they also decreased the exciting current, thus multiplying the action.

A solution adopted sometimes for large machines is to place a small exciter on the alternator shaft, but this is not a solution at all; it is merely doing away with an additional prime mover, which is, of course, advantageous, but involves a corresponding loss, since the speed of the exciting armature is affected directly by the load on the alternator.

Besides being able to furnish its own exciting current, the direct-current machine has another advantage over the alternator, for by means of a series winding a simple and effective method of regulation is obtained. There have been many attempts to extend this method to the alternator, even when the principle of self-excitation has been abandoned. The compounded or so-called compensated alternator is an instance of this kind. The main current or a portion of it is led directly, or by means of a transformer, through a set of series windings on the main field, passing, of course, through a rectifier on the way. This comparatively simple arrangement is only partially satisfactory, for not only are rectifying commutators, as a general thing, undesirable, but, in addition to its other disadvantages, the alternator is more sensitive to the kind of load it is carrying than is the direct-current machine. Its regulation is affected not only by the amount of the armature currents, but by their phase as well. The regulation on non-inductive load may be several times as good as it is on a very inductive load. Attempts have been made to utilize these reactions in the alternator in order to effect a more perfect compounding, but as yet no one plan has come into general use.

During the last few years attention has been turned again to the question of self-excitation of alternators. Notbaly Heyland and Latour, in Europe, have each devised a method by which a portion of the current generated in the armature may be passed through a suitable exciting coil and thus serve to magnetize the fields. These are polyphase systems and are somewhat complex, and although the reports of performance have been encouraging, for some reason neither system has been adopted to any extent. Both of them require a somewhat complicated and expensive commutator.

A recent attempt to solve this difficult and troublesome problem was described at the recent meeting of the American Institute of Electrical Engineers by Mr. E. F. Alexanderson. The striking feature of this new method is its simplicity, both as regards the methods of providing the initial excitation and the compoundng or regulating excitation and as regards the com-

mutator. The latter is a rectifying commutator pure and simple. It consists of one segment for each pole. On the armature is placed an auxiliary winding for supplying the field current. As the machine is three-phase, this is a three-phase winding and is connected to three sets of brushes pressing on the commutator. The brushes are so set and the commutator so proportioned that the three currents do not overlap. The compounding action is effected by opposing to the electromotive forces set up in the auxiliary winding electromotive forces produced by a three-phase series transformer connected in the leads from the alternator. Since the auxiliary winding can be placed at any point on the armature, its electromotive forces can have any phase desired with respect to the main electromotive forces. In general they are placed so that the currents set up by the auxiliary winding will be in quadrature with the main current on non-inductive load. By this means a change in the phase of the main current reacts upon the exciting current so as to correct for the change in armature reaction due to the change in the character of the load. The method would seem to have the decided advantage of being inexpensive. The windings required are simple, the commutator is not complicated, and the additional burden put upon the alternator itself is slight. It is to be hoped that further information regarding this new machine will agree with the encouraging views held by Mr. Alexanderson. So many attempts have been made to solve this old problem that the electrical world is justified in examining very critically any new proposal. If the machine will do all that is claimed for it, there can be no doubt that it will find a very useful place in the power-house.

CHEMISTRY IN ENGINEERING.

Chemistry is one of the required subjects in engineering courses at our technical schools. Generally speaking, the amount of time which can be devoted to this branch of knowledge is so slight that the student gains only a general idea of the fundamental principles; he learns, we may say, what chemistry is, but that is about all. What he does know is useful to him in a number of ways, but it is far from being a working knowledge of chemistry. This being the situation, it seems strange that the engineer should be so backward in turning to the chemist when the latter can be of assistance to him. One would think that after learning what chemistry is and what it can do, the men who are so largely responsible for the success of great undertakings would not neglect such obvious opportunities for improving their methods or reducing the cost of operation. The engineer, we may say, deals with the forces of nature and the chemist with the materials. It seems absurd to suggest that either one can get the best results without seeking assistance from the other. Yet, every day glaring examples of this very thing are seen on every hand.

To be a little more specific, take the problem of the boiler house. To transfer the heat of the fuel to the water in the boilers is a physical problem. It is for this reason that it has received the greatest amount of study from the steam engineer. On the other hand, the burning of the fuel on the grate is a chemical problem, and consequently it has been sadly neglected. Of course, every manager of a boiler house seeks to evaporate as much water as possible for each ton of coal he purchases, or, rather, each dollar he pays out for coal; but seldom is the matter looked upon in the right light. What the engineer is looking for is heat units delivered to the boiler. What he should purchase, therefore, is heat units and not pounds of coal. The correctness of this principle is being recognized now, in some cases, at least, and the practice will probably spread, since this method of securing fuel has been adopted by one of the largest power-houses in the country. Yet this very method of buying coal has been practised for the past ten years in one of our principal cities without attracting any attention from engineers at other points.

Briefly, the argument is this: since the engineer of the power-house wants heat units, he pays for his coal a sum proportional to the heat units contained in it. If the coal contains water a certain amount of heat will be carried off in the steam which will be set free during combustion; hence a wet coal is less valuable than a dry coal having the same thermal value. Further, ash is detrimental in coal, as it not only interferes with combustion, but must be got rid of; therefore coal having a large percentage of ash is worth less than one having a smaller amount. Both of these factors are taken care of when one buys his coal at a price proportional to its useful heat units. Every ton of coal should be purchased in this way and every new delivery should be sampled to see that it comes up to the chemist's specifications.

This method of purchasing is as fair to the coal dealer as it is to the purchaser. The one has something to sell and the other buys it at its true value. Moreover, by proper attention to the specifications, the dealer can frequently increase the value of his coal. An instance of this kind was brought to notice recently when a certain coal was condemned by a large power company because it did not meet the specifications. The coal company at once sought the aid of a chemist, who examined the coal and told the company that all that would be necessary to bring the coal to the proper standard would be to have it hand-picked. This was done at an expense of two or three cents per ton, but the result was meeting the requirements and giving the coal company a bonus of thirty cents per ton on their product.

In almost every department of an electrical system there is opportunity for improvement through expert chemical advice. The company referred to above, which had been purchasing its coal on specifications for some ten years, has adopted the same method in obtaining nearly all its supplies. All of its bearing metals are bought on specifications, so that the company pays for just what is in the metals and nothing for a fancy name. In the same way the cost of oils was cut down to an almost ridiculous figure. Paints, metal for trolley wheels, water-softening compounds—in fact, almost every material which has to be bought—should be submitted to a chemist, who can see to it that the purchaser gets what he thinks he is getting. This is merely introducing scientific methods into business, and it is doubly strange that the engineer, who prides himself so much on his scientific way of doing things, should pay so little attention to the value of the chemists' methods.

INSTRUMENTS AS A FACTOR IN DEVELOPMENT.

During the discussion of Mr. H. G. Stott's paper on "Power Plant Economics" at the recent meeting of the American Institute of Electrical Engineers, Mr. E. W. Rice called attention to the great assistance rendered to the electrical designer by accurate instruments. In this he is favored beyond other engineers, for he has available instruments not only for measuring the total amount of work done, but for indicating the rate at which work is being done at any time and for indicating the values of the various factors which enter into the work. From his ammeter and his voltmeter he knows at any moment the values of these two components; the wattmeter saves him the trouble of multiplying and of allowing for the disturbing factor when the two components are not in phase. Becoming used to such easy and accurate methods of measuring, he has rebelled against the cruder and more troublesome methods which the mechanical engineer is forced to employ. He seldom employs an apparatus as crude as the prony brake, if there be any way of getting around it, preferring, indeed, to convert the mechanical output of his motor into electrical power and thus to measure it, allowing for the losses due to conversion, or to follow the reverse process when it is a generator which is to be tested. He has even extended his methods further by the production of an electrical speed indicator, which shows at a glance not only the speed itself, but the rate at which this speed may be changing. Even that honorable old instrument, the thermometer, is discarded for much work in preference to a thermo-couple and a galvanometer or a wire resistance. The convenience and accuracy of his instruments has undoubtedly been an important factor in the rapid development of electrical machinery.

There is, however, another phase to this question. As a general thing improvements in apparatus are forced upon us rather than sought, though the impelling force may be commercial as well as physical. The old reciprocating steam engine, for example, developed slowly. The first great step in this direction was due to the invention of the indicator by Watt, but since his time changes and improvements have been brought about slowly. There was not an imperative need for improvement, because the losses in the engine were simply carried back to the coal pile; the engine itself did not suffer. In electrical apparatus, on the other hand, the losses which take place are detrimental to the machine itself. Besides affecting its operation they appear as heat, which, if it be not properly carried away, will destroy the machine. It is the rise in temperature of an electrical machine that, in general, limits the work which it may do. There are in some cases—for example, in certain direct-current machines—apparently other limiting factors, such as commutation, but poor commutation is bad because the heat developed at the brushes destroys them and the commutator. The electrical designer was forced, for these reasons, to limit the losses in his machines to an amount which could be properly dissipated.

Under ordinary conditions, in apparatus of similar design, the amount of heat which can be got rid of is proportional to the surface; the losses are, in general, proportional to the volume. As size increases the losses increase as the cube of the dimensions, but the radiating surface increases only as the square. For this reason, unless improvements in design were made which reduced the losses, or methods devised for dissipating more heat, the limiting size would soon be reached. The electrical engineer was therefore forced to make his design more efficient if he wished to build larger machines; and this compulsion would exist whether there were but one or one hundred manufacturers of electrical apparatus. It is true that the better design would bring a better price, and this is an additional reason for improvement; but it is not the main reason, as it is in steam engineering, where a better engine is made simply because the maker hopes by that means to get ahead of his rivals.

The steam turbine, in this respect, is in the same class as the reciprocating engine; losses in the turbine do not tend to destroy it. But the turbine is, unfortunately, in a worse position than the reciprocating engine, for we have as yet no means of measuring directly the work put into the turbine in the steam; it can only be got at indirectly. This is unfortunate, as it can not but make improvements in turbine design the more difficult; and it is probable that this is one of the causes why the steam turbine has been so long in obtaining recognition, although it has long been admitted to be an ideal type of engine.

The gas engine is, in one respect, better off than the turbine, since by means of the indicator we can get an idea of the work developed by the gas; but, in some features, the gas engine resembles electrical apparatus. Undue rise in temperature must be avoided to enable the machine to carry its full load. While the excessive heat may not be as disastrous to a gas engine as it is to a dynamo, it nevertheless reduces the load which the engine can carry and must, for this reason, be prevented.

Were the designers of the last two prime movers as favored as are the builders of electrical machinery in having accurate indicating instruments, we might look for a more rapid development; but while hampered in this respect, the mechanical engineer is not discouraged. He is accustomed to such difficulties and perhaps would not realize them as such did not the more favored electrical designer take pleasure in pointing out his own happier position.

THE ELECTRICAL NATURE OF MATTER AND RADIOACTIVITY.

With this issue of the ELECTRICAL REVIEW the notable series of chapters on "The Electrical Nature of Matter and Radioactivity," by Dr. Harry C. Jones, of Johns Hopkins University, is brought to a close. Dr. Jones has covered thoroughly this new field of investigation, which is of absorbing interest to the layman as well as to the scientist. The final chapter deals with the more recent work and thus brings the subject up to the present time.

THE ELECTRICAL NATURE OF MATTER AND RADIOACTIVITY.

(Concluded.)

BY HARRY C. JONES.

CHAPTER XVIII.

RADIOTHORIUM—A NEW RADIOACTIVE ELEMENT.

A new radioactive element has recently been described by Sir William Ramsay. Reference has been made to this substance somewhat earlier by students of Ramsay, but the first satisfactory account of the discovery and the element discovered has just been given by Ramsay himself. It was found in a mineral obtained from Ceylon. Ramsay obtained about two hundred and fifty kilograms of the mineral, having become interested in it on account of the large amount of helium that it contained. One gram of the mineral gave about nine cubic centimetres of helium gas, which was between three and four times the amount obtained from cléveite.

It is of interest to know that Ramsay has already obtained from the mineral about one cubic metre of helium gas, and we can look for some interesting results in reference to the properties of this substance. It is well known that this is the only gas that has thus far not been liquefied, and this is mainly due to the fact that a sufficient quantity had not previously been obtained. It is highly probable that with the amount of helium now at disposal, it will be possible to convert it into the liquid state, and then the last of the most resistant gases will have succumbed to modern methods of liquefaction. The new element was obtained from the mineral, which was named "thorianite," in the following manner: The mineral was fused with sodium disulphate. The residue insoluble in water was treated with dilute, boiling hydrochloric acid. The insoluble sulphates were then fused with sodium carbonate, which transformed them into carbonates. The barium carbonate obtained was strongly radioactive and contained the radioactive matter in the mineral. The radium was separated by the method devised by Giesel, *i. e.*, by fractional crystallization of the bromides. It soon became obvious that there was present a radioactive constituent other than radium. Its bromide was even more soluble than the bromide of barium.

The chemical properties of the new substance show that it is not identical with any known element. It resembles in general the rare earths. It is to be distinguished chemically from radium in that it forms a soluble sulphate, and from thorium in that its oxalate is insoluble in an excess of ammonium oxalate. The new substance gives off an emanation, which has the same properties as the thorium emanation. Its rate of decay is the same as that of the thorium emanation, and the excited activity produced by the emanation from the new substance diminishes at the same rate as that produced by the emanation from thorium. The oxide, after being strongly heated, but not otherwise, glows in the dark. A similar result is obtained when one of the salts is cooled in liquid air, but not to the same extent.

When a few milligrams of the new substance are wrapped in paper and placed in front of a screen of zinc sulphide, a phenomenon manifests itself similar to that observed in the spinthariscope. Ramsay has measured the radioactivity of radiothorium. In making these measurements solutions of its salts were used, since these gave more constant results than the solid salts. It was found that the amount of the emanation obtainable from a given quantity of the radiothorium was equal to that obtainable from *five hundred thousand* times as much thorium. The relative powers of radiothorium and radium to discharge the electroscope have also been tested. It was found that radiothorium has apparently about half the discharging value of radium.

Sir William Ramsay summarizes the results that he has obtained with radiothorium as follows:

The emanation given off by radiothorium is identical with that given off by salts of thorium. The quantity, as we have seen, is infinitesimal in the case of thorium compared with the amount given off by radiothorium. The conclusion is that ordinary thorium probably contains a trace of radiothorium to which it owes its radioactivity. Ramsay announces that he has already succeeded in separating a part of the radioactivity from the thorium by adding to the thorium salt a salt of barium, and then adding sulphuric acid. A part of the radiothorium is probably brought down along with the barium salt.

Analogous to the decomposition products of uranium, Ramsay suggests the following scheme as representing the probable decomposition products of thorium.

Inactive thorium — radiothorium — thorium X — emanation — thorium A — thorium B?—helium.

There seems to be no doubt, according to Ramsay, that the helium found in thorianite is produced from the radiothorium present in that mineral.

"RADIOBES" DESCRIBED BY BURKE.

In discussing the work of Burke, let us see first why he undertook the experiments about which so much has been written and said, and then see what are some of the results obtained. He was studying phosphorescence and wanted to see whether it could not be produced in certain organic bodies by exciting agents.

He introduced some crystals of radium bromide into glycerol, and then plunged the whole into liquid air. He thought that these conditions were favorable for the condensation of the molecules around the ions from the radium.

Crystals of glycerol were obtained. It was, however, found that the presence of radium was not necessary in order to obtain this result, crystals of glycerol being formed at the low temperature of the liquid air when no radium was present, just as would be expected.

Similar results were reached when gelatine was used instead of glycerol. At the low temperature of the liquid air microscopic crystals were produced.

Burke then used bouillon which had been sterilized at a temperature from 130° to 140°, and found that after a couple of days a "culture" began to grow on the surface. This result was obtained whether the bouillon was immersed in liquid air or not.

The natural conclusion was that the bouillon had not been completely sterilized. To test this point check experiments were made. Some of the same bouillon was placed in tubes and subjected to exactly the same conditions as bouillon to which the radium had been added. No "cultures" appeared in any of these tubes, while they did appear in all of the tubes to which the radium had been added.

In the earlier experiments the chloride of radium was used. The "cultures" were studied with respect to their power to produce other "cultures" and inoculate other media. Burke says that for the first six weeks there was no sign of any sub-cultures. After this time there seemed to be a slight tendency toward development but this was only very slight.

In his later experiments Burke used the bromide of radium. This was introduced on to the surface of bouillon which had been sterilized at 130° for a half-hour. The bouillon in the test-tube was protected from contamination by closing the tube in the usual way with cotton wool. Signs of the growth of the "cultures" began to manifest themselves after about a day.

These forms were not all of the same

size but differed from mere specks to sizes of appreciable order of magnitude under the miscroscope. Burke concludes from this that they are probably a growth from sizes too small to detect with the microscope.

These forms might, from their appearance, be calcium carbonate, but they were found to differ in properties from this substance.

At first there was no sign of any structure as seen under the microscope. Later, however, a "nucleus" manifested itself and subdivision took place, giving rise to a new individual. This subdivision usually manifested itself after the body had reached a certain definite size.

The above properties, especially the "nucleation," "growth" and "reproduction" by division, Burke thinks are sufficient to place them in the class of living things.

These forms are obviously not bacteria. If they are living forms at all they are of a much lower order than bacteria and Burke suggests that possibly they occupy a position between crystals and bacteria.

These forms have been termed by Burke "*Radiobes.*"

A suggestion has been made concerning Burke's radiobes which has attracted considerable attention. It has been suggested that these forms are nothing but crystals.

Burke replies to this criticism and presents a number of arguments against the possibility of the radiobes being merely dead matter in the crystalline condition. Indeed, it is very difficult to see how the characteristic properties of the radiobes as described by Burke can be accounted for on the crystal theory. The fact that they subdivide, together with the fact that they apparently become nucleated, are difficult of explanation in terms of their crystal nature. All in all, it seems highly probable that the crystal theory of the nature of the radiobes is insufficient and will have to be abandoned.

Another suggestion has, however, been made in reference to the origin and nature of the radiobes, which deserves special consideration. Sir William Ramsay has offered what he considers a possible explanation of the nature of these forms. It will be remembered that Ramsay and Soddy were the first to isolate the emanation from radium, which, however, had been discovered somewhat earlier by Rutherford. They showed that it was a gas which could be condensed to a liquid by liquid air, and which gave as one of its decomposition products helium.

A solution of the emanation in water decomposes the water yielding oxygen and hydrogen. The solution of the emanation in water also has the property of coagulating albumen. In the albumen it doubtless forms at first very small, and probably ultra-microscopic aggregates or cells.

When an aqueous solution of the emanation is injected into living matter it coagulates the albumen and becomes surrounded by a sack like the walls of a cell.

Ramsay says he thinks these facts are sufficient to account for the phenomena observed by Burke. When the radium bromide powder was sprinkled on to the gelatine it naturally sank a little distance below the surface. The emanation would act upon the water in the gelatine and decompose it, liberating oxygen and hydrogen. These bubbles of gas would become surrounded by sacks, due to the coagulating action of the emanation on the albumen. They would thus *appear like cells.*

The bubbles would at first be very small, probably of ultra-microscopic dimensions. They would gradually increase in size, as more and more water was decomposed and would thus *appear to grow.* The contents of the supposed "cell" would be gaseous—a mixture of oxygen and hydrogen, and also some of the emanation.

The emanation inclosed in the sack would continue to decompose water, which would diffuse in through the sack, and gases would accumulate inside the sack until the walls would finally give way. As the mixture of hydrogen and oxygen would pass out through the rent in the walls they would carry some of the emanation with them. This would coagulate more of the albumen with which it came in contact and form a new cell attached to the old one. If the original cell burst in several places we might have several new cells or buds formed from the original cell. This condition might easily be interpreted as reproduction, in the sense in which such organisms as yeast, for example, reproduce. Thus the *apparently reproducing power* of the radiobes is explained.

It is possible that such cells would show a structure on staining, since the coagulated albumen would probably stain very differently from the uncoagulated.

Whether this explanation offered by Ramsay accounts for all the phenomena observed by Burke or not, it is certainly worthy of very serious consideration.

In this same connection a fact very recently discovered by Rudge should be mentioned. He also has studied the effect of salts of radium and other elements on gelatine. The salts of a number of the metals, such as barium, strontium and lead produce the *same effect upon sterilized gelatine* that has been observed and recorded for the salts of radium. As Rudge points out, these "growths" are not in any sense to be regarded as vital. He thinks that the action of radium may be due to the barium that is contained in it.

In this connection it might be pointed out that the discovery that radium would even aid the life-processes would be very remarkable in the light of what is known concerning the action of radium on living tissue. We have seen, from the brief account of the physiological action of radium that it tends to kill living things. This disintegrating action has been experienced by more than one experimenter who has worked with fairly pure radium salts, and its action upon cancerous tissue is probably connected with this same property.

It does not seem probable that a substance which behaves in this manner would be one that would even aid the growth of living matter, much less produce it.

THE ALPHA PARTICLES.

Some interesting and important investigations on the α particles sent off by radium have very recently been made. Certain results obtained by Bragg and Kleeman have thrown new light on the nature of these particles as sent off by radium in its various stages of decomposition. They determined the ionizing power of the α particles, and from the nature of the results obtained, seem justified in concluding that the alpha particles given off by radium in any one stage of its decomposition, are of the same nature.

When radium is in radioactive equilibrium, we have alpha particles given off with very different velocities. This is due to the fact that the several products of the decomposition of radium are all present. It is an important and interesting fact to know that while the alpha particles given off by the different stages through which the radium passes, have different velocities, the particles given off by radium in any one of its stages of decomposition all have the same velocity, and the same ionizing power.

The following interesting, although empirical relations, have apparently been established by Bragg and Kleeman. The so-called "stopping power" of a number of the elements for the alpha particle, was determined, with the result that the amount of energy spent by the α particle in passing through an atom seems to be

proportional to the square root of the atomic weight. Quite a number of elements have been brought within the scope of the investigation, with the result that the above relation seems to hold approximately.

They have also shown that the number of ions produced by an alpha particle is the same, no matter what the nature of the gas through which it passes, and, further, that the same amount of energy is always required to make a pair of ions, regardless of the nature of the atom or molecule from which they are made.

This latter relation is probably very important, since it shows that ionization is essentially the same process, regardless of the nature of the molecules of the gas in which it takes place.

The deflection of the alpha particles in a magnetic and in an electrostatic field, has recently been determined by Mackenzie, working in the laboratory of J. J. Thomson. By this means the velocity of the particles could be determined, and also the ratio of the charge e to the mass m. In this work radium which was in radioactive equilibrium was employed. Under these conditions radium is sending out alpha particles with very different velocities, and what is really determined is the mean velocity.

In the magnetic deflection of the rays the alpha particles from the radium entered a brass vacuum box by passing through a thin sheet of mica. The rays passed through a vacuum for about fifteen centimetres, and then fell on a zinc sulphide screen. The line of scintillations was then photographed.

The poles of an electromagnet could be placed along the path of the rays, and when the magnetic field was applied the usual deflection of the alpha particles took place. This was registered photographically.

The mean value found for $\frac{mv}{e}$ was 3.00×10^5, varying between the extremes 2.5×10^5 and 3.7×10^5.

The value of $\frac{mv}{e}$ found by Rutherford for radium in radioactive equilibrium is 3.9×10^5. The value of Mackenzie must be corrected for the decrease in the velocity of the particles produced by passing through the thin sheet of mica. The corrected values are as follows: The average value of $\frac{mv}{e}$ for the alpha particles as they leave the surface of the radium is 3.18×10^5; the extreme values being 2.65×10^5 and 3.92×10^5.

In measuring the electrostatic deflection an apparatus was employed which was similar in many respects to that used in measuring the magnetic deflection. The alpha rays entered the apparatus by passing through the mica plate, but they were now passed between two plates charged to a difference of potential as great as 10,000 volts.

The value found for $\frac{mv^2}{e} = 4.11 \times 10^{14}$.

The value of $\frac{mv}{e} = 3.00 \times 10^5$.

The average value of $v = 1.37 \times 10^9$ centimetres per second and $\frac{e}{m} = 4.6 \times 10^3$ electromagnetic units.

The value of $\frac{e}{m}$ for the hydrogen ion is 10^4. If we assume that the alpha particle carries the same charge as the hydrogen ion, the value of m, or the *mass of the alpha particle, is about 2.2 times that of the hydrogen ion.* This is very close to the mass of the hydrogen molecule.

This work, then, does not favor the view that the alpha particles are helium ions, their mass being only about half that of the helium ion. Mackenzie points out that both hydrogen and helium may be given off simultaneously from radium, but this is certainly far from proved.

We must therefore still be cautious in drawing the conclusion that the alpha particles are nothing but helium ions.

The magnetic deflection of the alpha particles from polonium was also measured, and these were found to have somewhat greater velocity than the average α particles from radium.

Their velocity, however, was not as great as the swiftest alpha particles from radium.

CONCLUSION.

The investigations, of which a general account has been given in these papers, mark a new epoch in the development of the physical sciences. Some of the results obtained are as important from the standpoint of the physical chemist as from that of the physicist.

Facts have been brought to light which are of a character that are very different from anything hitherto known. *The existence of extremely penetrating forms of radiation, the instability of the chemical atom, the formation of one elementary substance from another, the existence of a form of matter that can charge itself electrically, that can light itself and that can give out an amount of heat that is almost inconceivably great,* are some of the facts to which men of science must now adapt themselves.

These are magnificent developments with which to open the new century. Probably still more surprising facts are awaiting men of science before its close. It seems not too much to predict that as the nineteenth century surpassed the preceding eighteen in the development of scientific knowledge and the discovery of truth, just so the twentieth century will exceed them all in the gifts of pure science to the store of human knowledge.

The wave of scientific investigation for its own sake that has recently swept over the entire civilized earth must yield a rich harvest to those who shall be permitted to reap it.

THE END.

The Illuminating Engineering Society.

A meeting of the Illuminating Engineering Society was held at the Hotel Astor, New York city, Tuesday evening, February 13. The report of the paper committee was received, which mentioned a large number of topics to be discussed during the coming meetings, and announced that the next meeting of the society would be held March 13, the second Tuesday, to hear read papers on mantle burners, on the flaming arc, and on the discussion of illumination from the viewpoint of the architect.

President L. B. Marks delivered an interesting address, in which he gave the reasons for the formation of the new society, and pointed out the important work which lies before it. President Marks gave statistics to show how inefficient illumination is as practiced to-day, and explained the relation of the new society to other technical organizations.

The address was discussed by Dr. Arthur H. Elliott, of the Consolidated Gas Company, New York city, who differed somewhat regarding the gas-lighting statistics as given in the president's address. Dr. Elliott called especial attention to the important physiological effects produced by over-illumination, and said that it would be well if the society could obtain the cooperation of physicians and oculists in the study of this matter.

Mr. Arthur Williams, of the New York Edison Company, spoke of the importance of educating the public in the use of illumination. Not infrequently a good deal of dissatisfaction is caused by the change in the color scheme of a room, thus spoiling the plan of illumination as it previously existed. Mr. Williams spoke also of the value and use of illuminated signs.

Dr. C. F. Chandler, of Columbia University, gave a most interesting review of the development of illumination, beginning with the whale-oil industry in the early part of the last century.

A number of others present took part in the discussion.

POWER FROM LAKE MICHIGAN.

BY ALTON D. ADAMS.

Six hundred thousand cubic feet of water per minute will presently flow from lake Michigan to the Mississippi river. In its course of 325 miles across the state of Illinois this water will fall 176 feet and thus transform energy at the rate of 200,000 horse-power. This great water power, if electrically developed and transmitted, is probably sufficient to displace every stationary steam engine in Chicago and the remainder of the state.

Power development on this great scale has been made possible by the construction of the Chicago Sanitary and Ship Canal from lake Michigan to Lockport, a distance of thirty-four miles. Six miles of this canal, from the Chicago lake front to Robey street, occupies the improved bed of the Chicago river and of the west branch of its south fork. This river section of the canal has a bottom width of 160 feet and a depth of twenty-six feet, and the flow of water is now from lake Michigan instead of toward it, as formerly. From Robey street to the controlling works at Lockport an entirely new channel 28.05 miles long, 160 feet wide at the bottom and twenty-two feet deep has been excavated.

Water from the controlling works is discharged into the channel of the Des Plaines river, which has been widened and deepened as far as Joliet, a distance of over four miles. From Joliet the lake Michigan water follows the channel of the Des Plaines river to its junction with the Kankakee, where the Illinois river is formed, and then flows along this last-named river to the Mississippi. The 600,000 cubic feet of water per minute thus to be diverted into the channel of the Illinois river from lake Michigan is sixteen times the natural low water discharge of that river at La Salle, and eight times the low water discharge at its mouth on the Mississippi.

Fortunately for the useful development of power with this water of the great lakes, most of its fall occurs along a small part of its course to the father of waters. From Robey street, in Chicago, to the controlling works, at Lockport, the canal lies entirely in excavation through the Chicago divide that separates the lake Michigan watershed from that of the Mississippi, and substantially the lake water level is available at these works. From the controlling works at Lockport to Utica, a distance of sixty-two miles, the fall of the Des Plaines and Illinois rivers is 140 feet, while from Utica to its mouth on the Mississippi the Illinois river falls only thirty-six feet in its course of 229 miles. That part of the river channels between Lockport and Utica is thus the only one suited to power development. In falling 140 feet along this sixty-two miles of river the 600,000 cubic feet of water diverted from lake Michigan per minute develop 160,000 gross horse-power. With good hydraulic works as much as sixty per cent of this gross power, or 96,000 electric horse-power, may be developed twenty-four hours a day for transmission to Chicago and other cities. Opportunities for power development are not equally good along this sixty-two-mile stretch of river, for much the greater part of the descent occurs between Lockport, at the brow of the Chicago divide, and the junction of the Des Plaines and Kankakee rivers, in a distance of twenty-one miles. Down the escarpment that marks the termination of the divide the Des Plaines river falls about ninety-four feet below lake level, in the distance just named, an average of nearly 4.5 feet per mile. This leaves a fall of some forty-six feet for the forty-one miles of the Illinois river between the mouth of the Kankakee and Utica. It thus appears that of the fall of 140 feet through which the water diverted from lake Michigan may be utilized for power development, sixty-seven per cent occurs along twenty-one miles of the Des Plaines river above the mouth of the Kankakee. A part of this stretch of river shows an even more rapid descent, for the fall from the low water level of 1847 on lake Michigan, at the controlling works, to the upper basin on the Des Plaines river, a distance of about 4.3 miles, is forty-two feet or nearly ten feet per mile.

These opportunities for water power development along the Des Plaines river are not lying neglected, but one of them, at least, is soon to be utilized to generate electric energy for use in Chicago. About two miles from the controlling works at Lockport, the sanitary district of Chicago, a municipal corporation of Illinois, is now building an electric power plant that is to have an ultimate capacity of 35,000 horse-power. This energy is to be transmitted to Chicago and other points in the district. A canal 10,700 feet long conveys water to this generating station, from the controlling works, and another canal 6,800 feet long acts as a tail race to discharge the water into the Des Plaines river. In this way a mean head of thirty-two feet is maintained for the water-wheels. There will be ten sets of these wheels on as many horizontal shafts, three sets for the exciting dynamos and seven sets for the main generators. Each set of main turbines is rated at 6,500 horse-power at full gate under thirty-four feet of head and at 150 revolutions per minute. At 8/10 discharge each set of main wheels is designed to pass 100,000 cubic feet of water per minute, and the ultimate discharge of the power plant is expected to reach 800,000 cubic feet per minute.

In Joliet, about eight miles down the Des Plaines river from Lockport, the sanitary district has done a large amount of preliminary work in the way of excavation for the purpose of another water power development.

Below Joliet, on this river, it seems that the electric development of the water power may still be open to private enterprise, and from this city to Utica the fall amounts to sixty-six feet in a distance of fifty-four miles. Of this total fall about fifteen feet is concentrated in a distance of three miles below lake Joliet, the name given to a nearly level stretch of the Des Plaines river, and some twenty feet occur along two miles of the river just below the Marseilles dam.

Most of the larger cities of Illinois are within a practicable radius of transmission from the stretch of river between Lockport and Utica. From the former place to the business section of Chicago is less than thirty-four miles. Elgin and Aurora are within a forty-mile radius of the same point, Peoria is about eighty miles, Bloomington seventy-five miles, Rockport eighty miles, Rock Island 110 miles and Springfield 143 miles, in a direct line, from the dam at Marseilles.

The Annual Meeting of the West Virginia State Association of Independent Telephone Companies.

On February 22 and 23 the annual meeting of the State Association of Independent Telephone Companies will be held at Parkersburg, W. Va. It is estimated that at least 150 delegates will be present from West Virginia, the Ohio valley from Pittsburg to Cincinnati, and from Western Maryland and Pennsylvania. The independent telephone business, it is said, is making strides in West Virginia, and there are now forty-five companies operating 41,000 telephones. This is exclusive of the mutual or farmers' lines.

One of the speakers will be James B. Hoge, Cleveland, Ohio, president of the National-Interstate Telephone Association, and a prominent figure in independent long-distance telephone companies.

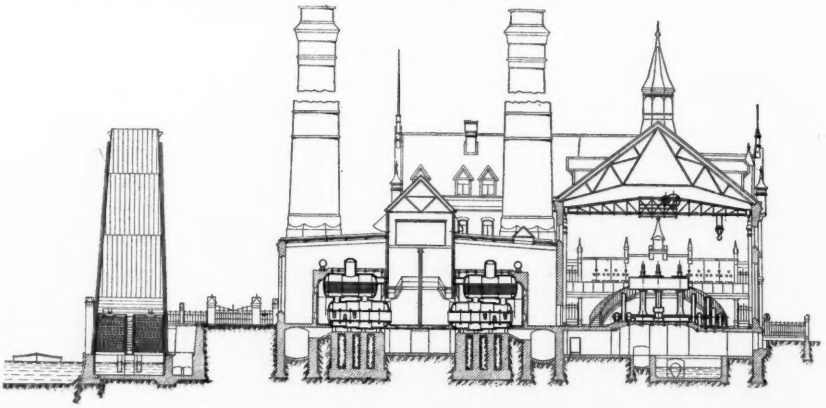
New Barmbeck Central Station Equipment at Hamburg.

By Frank C. Perkins.

ONE of the accompanying illustrations shows the power station at Barmbeck, in the suburbs of Hamburg, Germany, with its water-cooling tower in the foreground and its two large stacks in the centre, the canal and the arrangements for handling the coal in the foreground. Other illustrations show the interior of the dynamo and engine rooms of the Barmbeck plant, the arrangement of the boilers and the electrical connections of the generators and switchboard.

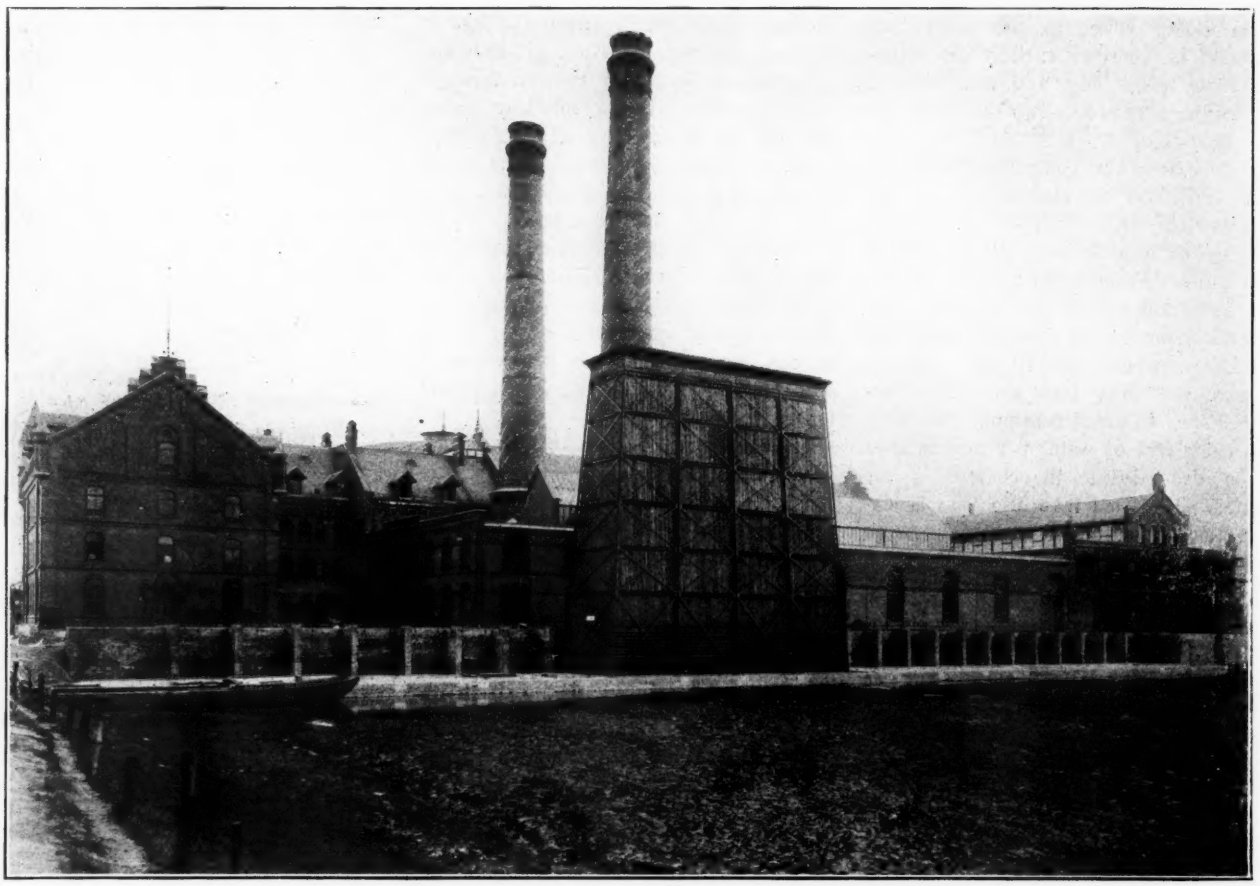
There are twenty-four boilers in the boiler room, each having a heating surface of 250 square metres. This boiler plant was designed to supply steam to three units from 1,000 to 1,200 horse-power capacity, and three units from 2,000 to 2,500 horse-power capacity. The engine room is fifty-eight metres long, nineteen metres wide and 12.9 metres high, and it is provided with an electrically operated crane of twenty tons capacity, constructed by the Duisburger Machinenbau Acktien Gesellschaft, formerly Bechem & Keetman, of Duisberg.

The boiler house is 27.1 metres wide and fifty-eight metres in length. It is provided with a portal crane operated by electric motors, with grab buckets for unloading the fuel from the boats and carrying it to the coal bunkers, from where it is conveyed by electrically driven labor-saving devices to the various coal bins for use as required. This electric crane was installed by the Eisenwerk Acktien Gesellschaft, of Berlin, formerly Navel & Kaemp, of Hamburg, and it has a capacity of handling 150 tons of coal each day of ten hours.



ELEVATION, BARMBECK CENTRAL STATION, HAMBURG, GERMANY.

The three smaller engines are of the triple expansion vertical type, constructed by F. Schichau, of Elbing, having a maximum output of 1,200 horse-power each. These engines are directly coupled to shunt-wound dynamos of 800 kilowatts

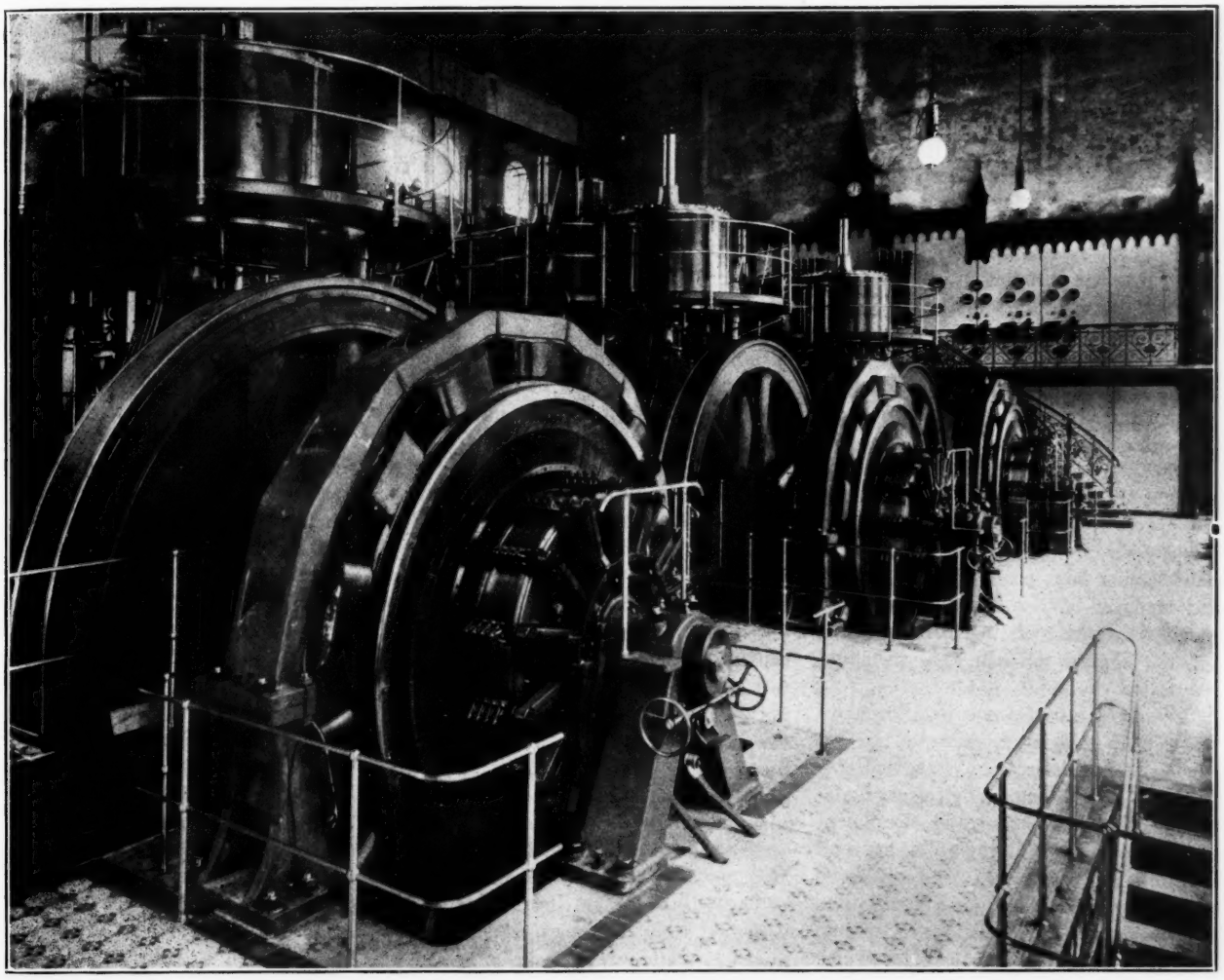


EXTERIOR VIEW, BARMBECK CENTRAL STATION, HAMBURG, GERMANY.

capacity, constructed by the Electricitats Actien Gesellschaft, formerly Schuckert & Company, of Nurnberg. Each of these electrical generators supplies current at a pressure of 600 volts and is utilized in charging a large storage battery, in addition to the power and lighting service, this battery being employed for taking care of the peak of the load and for regulation. The three large engines of 2,500 horse-power capacity were intended to be directly coupled to continuous-current dynamos of similar construction, each having a capacity of 1,750 kilowatts. One of these large units includes a reciprocating engine of the vertical type, the current from the generator of this unit being utilized for lighting and railway service. Instead of installing two additional engines of the vertical reciprocating type of 2,500 horse-power each, it was decided in the new equipment to install three steam turbine units. Each of these steam turbines is directly coupled to a three-phase alternator having a capacity of 2,000 kilowatts, supplying a polyphase current of 5,000 volts pressure.

The three-phase current from the alternators is conducted through the transmission lines to substations provided at Eppendorf and elsewhere for transforming the same to a direct current of 600 volts pressure for lighting and power distribution.

The storage battery equipment consists of 144 cells for lighting purposes arranged on the three-wire system at 250 volts pressure. This battery has a capacity of 4,536 ampere-hours with a three-hour discharge, the rate of discharge being 1,512 amperes.



ENGINE ROOM, BARMBECK CENTRAL STATION, HAMBURG, GERMANY.

The first passenger train through the Simplon tunnel, which extends from Brigue, Switzerland, to Isella, Italy, a distance of twelve miles, was run on January 25, 1906. The tunnel was built through the joint efforts of the governments of Italy and Switzerland, the cost, outside of traffic arrangements, being in the neighborhood of $15,000,000.

ISOLATED PLANTS.[1]

BY H. L. WOOLFENDEN.

One of the hardest and most frequent, and at the same time one of the most interesting problems which confronts the central station manager is that of the isolated plant. Not only is he certain to see such plants installed from time to time, where he figures the business legitimately belongs to him, but he has also to deal periodically, with such tact and patience as he may possess, with the kicking customer who threatens the installation of his own plant. To a large extent the measure of the success of a central station is the scarcity of the isolated plant, as the type of building in which a separate plant is installed almost invariably offers a very considerable day power-load.

The purpose of this paper is not to endeavor to decide on the advisability of

[1] A paper read before the Colorado Electric Light, Power and Railway Association, Glenwood Springs, September 18, 19 and 20, 1905.

isolated plants, but rather to offer some data on a typical office-building plant of which the writer had charge in one of our eastern cities, and to touch in a general way on some of the more prominent features, in the hope that it may bring out discussion of value to the associate, as well as the active members of our association.

Accurate record of the cost of operating the plant is rarely kept in the case of our office and store buildings, and still more rarely in the case of the factory plant. The average owner, where complete records are not kept, will, in most cases, figure the cost of operation as being the cost of his fuel plus the cost of labor and supplies, and he is not always sure of even these items. It is undeniable that a considerable number, and possibly the majority, of small plants really cost the owners more to operate than similar service from the central station.

The original installation of the plant may be fully warranted, or it may be due to the over-anxiety of the salesman to increase his monthly average without really knowing the merits of the case; or it may be upon the advice of the operating engineer, who might easily be unconsciously biased by personal considerations. Unfortunately, if the plant is once installed and proves more costly than central station service would have done, the investment having been made, the central station manager is then called on to figure his price against operating expenses alone, and not against the real cost, including investment charges.

The results attained in a building plant will depend to a large extent on the distribution and character of the load, the capability of the engineer in charge, and also on the arrangement and location of the plant in the building. We have all seen building plants, and plenty of them, with low ceilings and poor ventilation, hot beyond endurance, and shoved into some corner of the basement for which seemingly no other use could be found. In such a case there is small incentive for the employés to keep the plant in respectable shape.

Probably the strongest argument in favor of an isolated plant in an office or other steam-heated building is the use of exhaust steam for heating during the heating season. A study of the load-curves, which are approximately correct for any office building, show that in the early morning, when the demand for steam for the heating system is heaviest, the load on the engines, and consequently the supply of exhaust steam is very light. At such times it is necessary to use live steam to make up the deficit. Late in the afternoon the reverse condition holds good, and there is usually an excess of exhaust steam. The greater part of the day the elevator load and what small lighting load there is will furnish enough steam except in severe weather.

The statement is frequently made that where all the exhaust steam can be used for heating in winter the isolated plant will prove more economical than outside service. This statement is not borne out by actual results obtained and is undoubtedly responsible for many unwise investments. Data published in one of the technical journals a few years ago showed that the average cost for some 150 buildings of various types in New York city ran from 3.1 cents per kilowatt-hour in a large fifteen-story office building to twelve cents in moderate-sized apartment buildings. These figures made no allowance for heating, the entire cost being charged to lighting and power.

The central station has, of course, the advantage of generating in large quantities. The cost of fuel should be lower, labor is very much less per unit of output, and the generating units are more efficient on account of both size and type. There is also a great advantage in the matter of investment charges in the fact that the central station requires a generating capacity of only thirty per cent to thirty-five per cent of the connected load, while the isolated plant requires a generating capacity of from 100 per cent to twenty-five per cent of its connected load, allowing for a maximum demand of about sixty-five per cent and providing for a spare unit. If the reserve unit is omitted the investment and depreciation charges are correspondingly reduced, but in such event breakdown service is ordinarily provided from outside at an appreciable cost.

The furnishing of steam for heating purposes from the main station or an auxiliary station would seem to be a most desirable and profitable thing where possible. Some of our Colorado towns are doing this.

Two points which are almost invariably overlooked in making comparisons between an isolated plant and central station service are the excessive use of light when furnished free, and the rental value of the space occupied by the plant. The extravagance in the use or misuse of light by the various tenants is rather strikingly shown by a study of the load-curves. For instance, on the December curve the load only gradually decreases from 5 to 10 o'clock at night, although many of the tenants are gone shortly after 5 and the majority of the offices are vacant at 6 o'clock. Numbers of lights are carelessly left burning and are turned off in one office after another by the scrub women who work in the building nightly from 6 to 9 P. M., and again from 6 to 9 in the morning. The July curve shows the light used by these same women in the summer time. A meter system would insure turning off these lights by the tenants on leaving the offices, and also would mean a very marked diminution of the current used during the day, much of which is used carelessly.

The rental value of the engine-room space is a difficult quantity to estimate. Undoubtedly in some cases it may be neglected entirely, where there is basement room standing idle after the building is full. On the other hand, it is of considerable value in a department store or in an office building where it can be rented for a restaurant or barber shop, as is frequently done.

Another item which is open to discussion is the allowance to be made for interest and depreciation, insurance, taxes, and general maintenance. The depreciation due to wear has up to the present been fully equaled by the depreciation due to change in design and practice. While standard apparatus has not changed much in the last three or four years, we can have no guarantee that it will not be radically different five or ten years from now. An allowance of less than fifteen per cent annually for these fixed charges would seem to be unsafe.

In comparing with outside service the cost of operating an isolated plant for lighting and power in a building which also uses steam heat, it is usual to consider it the difference between the total cost of operating the plant and the cost for heating and general service alone. Except in rare instances the latter quantity is necessarily estimated, but can usually be approximated closely.

The building referred to in this paper is eleven stories in height, with a total floor area above the basement of 95,800 square feet, of which approximately 74,600 square feet is for offices and 21,200 square feet for halls, toilets and public spaces. The ground floor is occupied by two banks, whose vaults are in the basement. Of the balance of the basement, approximately half is given up to the boiler, power and elevator plant, and the remainder is used for bicycle space and general storage.

The total number of lights in the building was, at the time these records were taken, 2,329, of which fifty-two were in the basement, 390 in halls and public

spaces, and 1,887 in the offices proper. This figures, above the basement, approximately one sixteen-candle-power lamp to each forty square feet of floor area in the offices, and one sixteen-candle-power lamp to each fifty-five square feet of floor area for the public spaces. The building is well lighted, although the display lighting on the ground floor is not as great as it would be if stores occupied the floor.

The equipment of the power plant consists of three horizontal water-tube boilers of a total capacity of 275-horse-power, two eighty-five-kilowatt, 125-volt direct-current generators connected to tandem-compound high-speed engines, and one fifty-kilowatt generator direct-connected to a simple high-speed engine, together with the usual complement of auxiliary apparatus, including feed and house pumps, hot and cold water tanks, etc. The elevator plant consists of five electric elevators, four of them being high-speed horizontal screw type for passenger service and the fifth one a slow-speed drum type for freight service. All four passenger elevators are normally in service, the schedule being such that no more than two elevators are on the up-trip at the same time. The starting characteristics of the elevator motors would not be considered in line with good practice in the latest type of elevator motor, as the flush of starting current is too heavy. This particular plant was installed about nine years ago.

At first considerable difficulty was met in the operation of both lights and power from the same engine. The engines had a rather sluggish governor and had been provided with a very heavy balance-wheel in addition to a heavy governor wheel. The action of the governor was too slow and a variation of three to four volts on the lighting circuits naturally resulted in a tremendous amount of kicking. The governor wheel of one engine was finally replaced with a light wheel with an inertia type of governor, and the balance wheel taken off, correcting the trouble almost entirely.

The power-load, which consists almost entirely of the elevators, is almost uniform at approximately ten kilowatts for the entire year. This, of course, is an average wattmeter reading, and the maximum momentary demands of the elevator system will at times go up to eighty-five or ninety kilowatts.

For the entire year the total kilowatt output was 240,756 kilowatt-hours. The coal used for all purposes, including heating and house service, was 1,479 tons. Pocahontas run of mine coal was used, on account of the city smoke ordinance, at a cost of $3.15 per ton. The labor connected with the plant included one chief engineer, one day and one night assistant engineer, one day fireman and one night fireman. In addition one extra man was employed for three months in summer, cutting the shifts down from twelve hours to eight hours. There was also a small monthly labor account for hauling ashes.

In figuring interest and depreciation, for the purpose of comparison, it is figured only on that portion of the plant which could have been omitted if electrical service had been taken from an outside source. This portion includes one-third of the boiler plant, the entire engine, generator and switchboard plant, and an allowance of $2,000 to cover the high-pressure piping and incidental items. The cost of this part of the building plant was $16,150. The total cost of operation for light, heat and power was, then—

Coal, 1,479 tons at $3.15	$4,658.00
Labor	5,340.00
Hauling ashes	144.00
Water (estimated proportion)	130.00
Oil, waste and sundries	355.00
Lamp renewals	192.00
Repairs	171.00
Fixed Chgs., 15 per cent of $16,150.	2,422.50
Total	$13,412.50

If, from the start, lighting and power service had been taken from outside, all of the items would have been omitted on which fixed charges are included above. Both assistant engineers would also be unnecessary, but a high-class man, such as the chief engineer, would be required. One fireman could also be dispensed with for six months each year. The cost of running the building under these conditions is estimated at—

Coal, 690 tons at $3.15	$2,173.00
Labor	2,550.00
Water	40.00
Repairs and sundries	60.00
Hauling ashes	35.00
Total	$4,858.00

Deducting this latter estimated cost of heating and house service from the total actual cost of light, heat and power gives us a net of $8,554, as the approximate cost of light and power only. On the basis of an output of 240,756 kilowatt-hours for the year the cost per kilowatt-hour is 3.55 cents.

The lowest published rate of the Edison company was four cents per kilowatt-hour, after applying discounts. We do not know how rigidly these rates are adhered to, but it would seem that, in view of the character of the load, the business would be desirable to the central station at the figure it cost the isolated plant in this instance.

THE ELECTRICAL DRIVING OF COLD-STORAGE AND ICE-MAKING PLANTS.

BY SYDNEY F. WALKER.

Power is required for cold storage and artificial ice making and in a great many instances, if there is an electrical service in the neighborhood, it is the most convenient power obtainable. In both cold storage and in ice making the heat that is required to be taken out of the air, the produce to be held at low temperatures, or the water, has to be lifted bodily, so to speak, and transported to the stream or the river from which the cooling water is taken; or where the cooling water is itself cooled by atmospheric aid, the heat is transported to the atmosphere and power is required to perform the operation. In order to accomplish it the heat to be dealt with is first caused to expand one of three substances, ammonia, carbonic acid, or sulphurous acid, from the liquid state to the gaseous state, and this is done either directly by what is called direct expansion, the agent passing through pipes which are immersed in the water from which ice is to be made, or are fixed in the cold chambers in which the produce is to be held at low temperatures; or the expansion of the agent from the liquid to the gaseous condition is made to reduce another liquid, technically called brine, to a low temperature, the brine being employed to extract the heat in its turn from the water or the cold chamber and what it holds by circulating in tubes through them. There is again another method, the air itself which enters the cold chambers is sometimes cooled before it is allowed to enter and this is accomplished by driving it over some form of cooling apparatus, such as a grid of pipes in which cold brine is circulating, or a battery of plates over which cold brine is trickling. In either case, after the agent, the ammonia, carbonic acid or sulphurous acid has done its work in extracting the heat from the brine, the water, or the air and produce, it is reconverted into the liquid form. In the arrangement known as the compression system, the gas is sucked into what is virtually a pump, where it is compressed and is afterward passed through a condenser, where it is exposed to the cooling action of water. Where there is a good supply of water at hand, such as a river or canal that is used, the water returns to the river after it has done its work; but in towns where water is dear, the cooling water is used over and over again, being itself cooled by being pumped up to the top of a cooling tower and allowed to trickle down over

mats or other obstructions, while exposed at the same time to an upward current of air. In the other arrangement, known as the absorption system, in which only ammonia is employed, the gas is driven off from an aqueous solution by the application of heat, usually by means of steam passing in pipes through what is called the generator, but after leaving the generator it passes to the condenser and through other vessels, known as the rectifier, the exchanger and others, all of which are subject to the action of cooling water. After condensation the liquefied gas prepared on the absorption system is used just as in the compressor system. Power is required then in the compressor system for driving the compressor and in both systems for driving the pumps which circulate the cooling water through or over the condenser, for driving the pumps which circulate the brine when it is used, for the fans when the air is cooled before entering the cold chamber, and sometimes when the chambers are cooled by direct expansion or by brine coils. Where the cooling water is cooled also, power is required to drive a pump to raise the cooling water to the top of the tower and to drive the fan which circulates the air through the tower. Fans are not always employed for this purpose, natural draught being made use of, but the fan makes the best arrangement. In ice-making plants, also, in addition to the above apparatus, there are others specially designed for producing chemically pure ice. The exhaust steam is generally made use of for making ice, but it is not sufficiently pure for ice that is to be used for the table. The steam, after being condensed, is subject to a process of reboiling, which forces any grease and other matters that may be present to the top, where they are skimmed off, and it is then subject to other processes designed to produce pure ice, some of which take power.

There are two other cases where power is required in connection with refrigerating apparatus. Small cold stores are often arranged to be cooled by means of ice, or ice and one of the salts used in the so-called freezing mixtures. In those cases the ice, or ice and salt, is contained in a tank placed in the upper part of the chamber with a trap for receiving the liquid as it is formed, and it is of great advantage to keep the air in the chamber constantly circulating over the cold sides of the tank. This is sometimes left to what would be called natural ventilation, due to the convection currents set up, but the circulation is much more certain if a small fan is employed, which can be worked by an electric motor taking current from the lighting service where there is one. Another case is where ice is made for use in hotels it is of advantage to cut it up into small cubes, which are placed on the table, much as sugar is. The arrangement spells economy in ice and is much more cleanly, as the waiter can hardly replace a half-melted cube in the ice dish. The machine for cutting up the ice into cubes is conveniently worked by an electric motor.

COMPRESSED AIR.

It should be mentioned that while the three agents mentioned above are those in common use, ammonia in particular being the favorite, ether was used for some time and is still used to a small extent in India on account of the low pressure at which it works. In the early days of cold storage, also, compressed air was very much used, especially for ship work. Compressed air plant is still made and used for the purpose, but it is being rapidly displaced by the other three agents. With compressed-air plant the air is compressed by a piston working in a cylinder in the usual way, but after compression the air is dried and is then cooled by allowing it to drive the piston of another cylinder whose piston rod is connected to the same crank shaft as that of the compressor, the power expended by the compressed air in what is called the expanding cylinder assisting the motor that is used for driving the compressor, the latter having only to supply the difference in power, plus that required to drive the air through the cold chamber and bring it back to the compressor. With the compressed-air system the air after expansion is cooled down, it is claimed by makers of compressed-air plant, to 100 degrees Fahrenheit and is then admitted to the cold chamber, the suction of the compressor drawing it out again after it has done its work, the air circulating round and round, with a small addition from the atmospheric air to make up for leakage. Compressed-air systems are not usually employed, except in direct connection with the cold chambers. There is rarely any brine circulation and the compressor is always fixed very close to the chamber, as the air so rapidly loses its cooling properties, to express it popularly, or heat so rapidly passes to it, to express it scientifically, so that long air circuits are not advisable.

WHERE THE POWER GOES AND HOW TO CALCULATE IT.

In the compression system the power is required to compress the gas to overcome the friction of the pipes through which the gas circulates, both as gas and as liquid, and in addition to overcome the friction of the moving parts of the apparatus —the piston, the valves, etc. As in every other case where power is used, the power which a cursory examination of the theory of the apparatus would dictate is usually a long way below that actually required. In compression the gas is heated and tends to expand, increasing the work the driving power has to perform. With steam engine driving the problem is increased in difficulty by the fact that the steam is at its weakest when the force opposed to it by the compressed gas is greatest, and the more economically the steam is used the more is this the case, so that on this account alone the electric motor, other things being the same, has a very solid advantage. But this is by no means the whole of the trouble met with in compression. Valves leak, both the suction and delivery valves, and this leads to waste of power in both cases. Compressors are of two kinds, double and single acting. In the single-acting compressor the piston draws gas in at one stroke and compresses it on the return stroke. With double-acting compressors gas is taken in behind the piston at each stroke and compressed in front of the piston at each stroke, so that suction and compression are taking place every stroke. If delivery valves leak, a certain quantity of gas escapes to the condenser not fully compressed and requires more cooling water to condense, while during the suction period some of it may work back into the compression cylinder, taking up some of the space that should be occupied by the gas from the expansion coils. Badly fitting pistons also give rise to leakage and to waste of power in the same way. And there is another trouble, more serious, in some cases. After the compression stroke the whole of the gas is sometimes not driven out of the cylinder, and on the commencement of the suction stroke this remainder, being highly compressed, expands, filling a portion of the suction space and reducing the efficiency of the apparatus, or, in other words, adding to the quantity of gas that has to be compressed and to the power demanded. The same troubles are met with in steam engines, but they are more accentuated in refrigeration apparatus. Several methods have been introduced designed to minimize these losses. In one form of compressor introduced by Dr. Carl von Linde, the piston is made hemispherical where it faces the end of the cylinder, the latter being also hemispherical, and in this way the clearance is reduced to a minimum and with it the possible gas left after compression. In another arrange-

ment the piston is brought right up to the end of the cylinder, the cross head of the piston rod being fitted with springs which enables it to do so without danger. In yet another method, the De La Vergne, an American system, oil is injected into the cylinder during each compression stroke and the gas and oil driven out together. This entails a separate arrangement for separating the gas from the oil before the gas passes into the condenser and a pump for lifting the oil that has been separated to its tank. The writer has dwelt on these points because, in his experience, one of the great difficulties in connection with the adaptation of electrical apparatus to new work is a proper estimate of the power required. Again and again have engineers sat at a desk and calculated what power ought to be taken by certain work, and after the apparatus has been put to work there has been continuous trouble, because there has not been sufficient power provided. It should not be forgotten either that the causes of loss mentioned, those due to leaky valves and pistons, are apt to increase with time, and what was sufficient power at first becomes insufficient as time goes on, so that the wise engineer will do well to provide plenty of power. There is no harm done if there is surplus, the repairs bill is sure to be less in consequence. The actual power taken by different apparatus in practical work is given below. Meanwhile it may be mentioned that with the exception of that taken up in overcoming friction of pistons, valves, etc., and the act of compression, the whole of the power required is to overcome the friction of the fluids, liquid and gaseous, through the pipes or ducts in which they circulate, and that the charge for friction follows definite laws which are very similar to those governing the passage of electric currents through conductors. The friction offered by any pipe to the passage of a fluid depends directly upon the extent of the surface of the pipe against which the fluid rubs, that is its internal surface, and on the square of the velocity at which it moves. This means that the longer the pipe the greater is the frictional resistance, just as with electric conductors. At first sight it appears as if the other law governing the resistance of electric conductors, that the resistance varies inversely as the section area, did not hold good here, but it is only an apparent difference. Increasing the size of the pipe through which any fluid is passing increases the internal surface and with it the internal resistance, if the fluid rubs against all the internal surface, but increasing the internal section of a pipe decreases the velocity at which the fluid is traveling, and as the resistance varies with the square of the velocity the total resistance is lowered. In fact the rule may be taken to hold that the resistance offered to fluid travel varies directly as the length of the pipe or duct and inversely as its sectional area. It also varies with the nature of the surface of the pipe and the fluid that is passing.

The above may be expressed by the following formula: $R = \frac{L\ P\ V^2\ K}{S}$

Where R is the resistance offered by a pipe or tube of circular section of length L, diameter S, and periphery P, K being a constant depending upon the nature of the surface of the pipe and upon the nature of the fluid. Where the duct is of square or rectangular section the factor P is obtained by taking the total length of the sides of the figure representing the section. With a square it is four times the length of one side, with a rectangle not a square, it is made up of twice the length of each pair of sides. The value of K has been determined for certain substances. One authority on refrigeration gives the value of K for gas circulating in iron pipes as 0.000936. Mining engineers have worked the figure out for air passing under the different conditions found in a mine, which are similar in many respects to those in the ducts of refrigerating apparatus, and they find it varies from 0.00033 up to 0.00263. The value of K for water has been determined as approximately 0.001, and it may be taken that with the same rubbing surface the friction will vary as the specific gravity of the fluid. The power required to overcome the friction of the fluids in pipes or ducts is found, as with electrical currents and mechanical work, by multiplying the weight moved per minute, by the pressure employed in moving it, or height of the columns of the fluid engaged in moving it, and dividing by 33,000. It is our old friend $W = E \times C$ under another name. We may write it power required to move the fluid in H. P. $= \frac{H \times Q}{33{,}000}$, where H is the pressure or equivalent column of the fluid, and Q is the weight of the fluid moved. Fluids are usually measured in cubic feet, or cubic metres, and the formula may be modified, if desired, to H. P. $= \frac{H \times Q \times w}{33{,}000}$, where w is the weight of a cubic foot or metre and Q is the number of cubic feet or cubic metres moved per minute. It need hardly be mentioned also that the denominator will be 550 if Q is the quantity passing per second. This point will be taken up again, when giving actual figures for the power taken.

THE PROPERTIES OF THE DIFFERENT REFRIGERATING AGENTS.

Ammonia (NH_3), carbonic acid gas (CO_2) and sulphurous acid (SO_2) are the agents employed in refrigerating work because they lend themselves easily to conversion from the liquid to the gaseous state, and vice versa, and because the quantities of each that it is necessary to handle come within practical limits. They are used for refrigeration because each absorbs a certain quantity of heat in passing from the liquid to the gaseous state—what is known as the latent heat of the gas. When water is heated the degree of heat required to raise the temperature of any quantity one degree is approximately the same throughout the thermometric scale until boiling point is reached, when there is a sudden demand for a large quantity of heat without any increase of temperature. One British thermal unit, approximately, is absorbed by one pound of water for each degree Fahrenheit that its temperature is raised; but when it passes into steam 966 British thermal units are absorbed without increase of temperature. Similarly, ammonia absorbs 555.5 British thermal units at 0 degree Fahrenheit, carbonic acid 123.2 British thermal units, and sulphurous acid 171.2 British thermal units. Hence it would appear at first sight as if ammonia was the most economical refrigerant. But the cooling performed by any refrigerant depends upon the volume of the gas formed. One pound of gaseous ammonia has a volume of 9.10 cubic feet, while carbonic acid has only 0.277 cubic feet and sulphurous acid 7.35 feet at the same temperature and pressure. Hence the latent heats per cubic foot are: for ammonia 61.7 British thermal units, for carbonic acid 447 and for sulphurous acid 23.3. This would make carbonic acid appear to be very largely the better. But again the pressure at which the different agents work are: ammonia 120 pounds per square inch, carbonic acid 900 pounds per square inch and sulphurous acid forty-one pounds per square inch. And there are other differences that can not be gone into here, but in practice the actual horse-power required is approximately the same for the same work, no matter which refrigerant is employed. It will be gathered from the above that as the cooling effect of carbonic acid per cubic foot is so much greater than that of the other agents the

compressor employed with CO_2 can be and is very much smaller than with either of the other two, but, as will also be seen, the pressure is very much higher, and though the gas is smaller in quantity the same quantity of heat has to be taken from it in the condenser by the cooling water. It is claimed by the makers of ammonia apparatus that carbonic-acid apparatus is not so efficient in hot climates, owing to the higher temperature of the cooling water. Apparently this is, or should be, true theoretically, but in practice carbonic-acid machines are working as well in the tropics as other apparatus. There is no difficulty whatever in providing for the increased pressure necessary in the tropics, and where the cooling water is cooled a warm atmosphere is an advantage. And that leads to another part of the question. The figures for the latent heats, etc., of the different refrigerants given above are for zero degrees Fahrenheit and the usual standard pressure, 29.92 inches of mercury, but they vary with the temperature and the pressure just as the same quantities do with steam. Increasing the pressure raises the temperature of its boiling point (the figure at which it passes into gas), while it at the same time decreases the latent heat of the gas at evaporating point while increasing the quantity of heat required to convert the liquid into the gaseous condition. On the other hand the heat of the tropics, by expanding the gas, increases the pressure at which it works and the work that has to be done on it in the compressor. The work done upon the gas in the compressor is converted into heat in the act of compression, and this heat has to be removed with that of expansion from the liquid state by the cooling water in the condenser. Hence the quantity of heat generated in the compressor is the measure of the work done upon the gas and of the horse-power required to accomplish it, apart from that lost in friction of the moving parts and the other losses that have been mentioned.

MEASUREMENTS OF REFRIGERATING WORK.

Refrigeration is measured by the ton; that is to say machines are built to accomplish one or more "tons of refrigeration," and this means that they will perform the same work in cooling as one or more tons of ice will in melting in twenty-four hours. In America what is called the short-ton is almost universally employed. It is 2,000 pounds. In the United Kingdom the long-ton is used, of 2,240 pounds. Each pound of ice requires the delivery to it of 142 British thermal units for it to become water at thirty-two degrees Fahrenheit, or, in other words, the latent heat of water is 142 British thermal units. This makes the American refrigeration ton 284,000 British thermal units per twenty-four hours, the British 318,080 British thermal units, and these figures are indicated by makers of machines; that is to say, a one-ton machine will provide compression sufficient to handle the gas that will extract 284,000, or 318,080 units from brine or any other substance in twenty-four hours. This is not, however, the ice-making capacity. The ice-making capacity is usually taken at half the refrigerating capacity. To freeze water it must first have its temperature lowered to the freezing point, which may absorb as many as forty or more units per pound, according to the initial temperature. Then the 142 units have to be extracted per pound and after that the temperature of the ice itself has to be lowered, so that it may remain solid and not be constantly inclined to melt. In addition there are numerous other losses, many of which have been pointed out, so that the above rule has been adopted in practice.

It will be seen that the ton of refrigeration works out to about 12,000 British thermal units per hour with the American ton and 13,250 British thermal units with the British ton. It is important to bear this in mind, as refrigerating machines are often arranged to run only a certain number of hours a day, and it is necessary in these cases that the full number of units should be abstracted during that time. The theoretical power required for a ton of refrigeration varies from 0.3 horse-power to 1.7 horse-power delivered to the compressor, and the practical brake-horse-power that should be available at the compressor piston-rod, to provide for all contingencies, may be taken as two and one-quarter horse-power. This is the smallest amount that should be allowed. In very small machines the power is slightly higher, and in very large ones slightly lower. The power also varies very much with the temperature of the cooling water, the hotter the cooling water the greater the power absorbed. The above figures are given for cooling water entering the condenser at fifty-five degrees Fahrenheit and leaving it at eighty degrees. The difference between the power required in temperate climates and in hot climates is taken at twenty per cent. The refrigerator which requires four horse-power in temperate climates requires five horse-power in hot climates, but it should be mentioned that this hardly takes account of the better cooling effect of a hot, dry atmosphere, where the cooling water is passed through a cooling tower. The above power is that required at the compressor, and is an addition to that required for driving the cooling water, brine and air through their various circuits. Compression refrigerating machines are made in all sizes; from very small, equal to about one-third of a ton of refrigeration per day up to 100 tons of ice making, or 200 tons refrigeration per day. The cooling that may be done with a ton of refrigeration varies very considerably with the materials to be cooled. As explained, in ice making only ten hundred-weight per day can be depended upon. For cooling chambers intended to preserve produce, the cooling work done will depend upon the temperature at which the substances are to be held, the quantity and the dimensions of the chambers in which they are stored. Every substance has its own specific heat, which again is different when frozen from that when not frozen. Each substance also has its own latent heat for freezing, and it is not a difficult calculation, having these given, to find the number of heat-units that must be extracted from the substance to lower its temperature to the degree required. Taking mutton, for instance, its specific heat when not frozen is 0.69, and its latent heat for freezing is eighty-eight British thermal units. It is usually held at about sixteen degrees Fahrenheit. Assuming that the animal heat is allowed to pass out before it is subject to refrigeration and that its temperature is then seventy degrees Fahrenheit, this means that about 10,000 units would have to be extracted approximately from every hundredweight of mutton to reduce it to the temperature at which it is to be held, and in addition to this the air of the chamber has to be reduced to a slightly lower temperature. After the produce and air have their temperatures reduced, the heat which leaks through the walls of the chamber has to be extracted. Cold chambers are built with insulated walls, in which masses of thermal insulating materials, such as silicate, cotton, finely-divided charcoal, cork and other substances are enclosed inside the usual brick or stone walls. There is no perfect thermal insulator, and one question the refrigerating engineer has to determine is the relative cost of extracting the heat that leaks through his walls, as against the cost of insulating them. There is a critical point in these cases where additional insulations are not economical. Cold stores are usually maintained at a low temperature continuously and this is

done with comparatively small expenditure of power, so long as the chambers are not opened frequently and so long as the produce is not frequently changed, Each new mass of produce that is put into the chamber requires an expenditure of power to cool it, and every time the chamber is opened heat passes in through the door.

Electricity has been adopted a good deal for driving compression plants, but principally for small plants up to the present, such as those for dairy work, tradesmen's plants, hospitals, etc., but there is no reason why it should not be employed for larger plants where the price of current is favorable. Where large plants are installed there is usually steam on the ground, and the tendency is to either drive the refrigerating apparatus by a strap from a shaft that is doing other work or to put up a separate engine taking steam from the main boilers. Gas is also a formidable competitor, as in other cases. Where the electricity supply is constant, in the full sense of the term, it should make a better drive because it is steadier. In ice making the ice suffers in appearance and in quality, if the speed of the compressor varies much, and the same thing holds in cold storage. The preservation of produce is gradually extending to almost every thing, not only what we eat, but some things that we wear, such as furs, and to tabacco, and other commodities, but it is important that the temperature at which they are held shall be maintained fairly uniform. It is better for the temperature to go up slightly in many cases than to go down, but both are bad. There is a certain temperature at which the processes that mean decay are arrested, but at which the substance itself is not damaged. If the temperature is lowered much below this figure the substance may be seriously damaged, while if it is allowed to rise a few degrees above the processes of decay may commence and can not afterward be stopped. It will probably be understood from the above that the power required for each case must be calculated by itself. The following figures from practical work will complete the matter: The one-ton machine, when running the full twenty-four hours, will hold a room of 1,500 to 3,000 cubic feet capacity at thirty-two degrees Fahrenheit, the two-ton machine a room of 3,000 to 6,000 cubic feet, and so on; a twenty-ton machine holds a space, which may be occupied by several rooms, of 1,000,000 to 2,000,000 cubic feet at thirty-two degrees Fahrenheit. They will hold larger spaces at higher temperatures and smaller spaces at lower temperatures. It should be mentioned that the power goes up rather rapidly as the temperature at which the room is to be held decreases after a certain limit is passed. The sizes of ammonia and sulphurous acid compressors are approximately the same as those of the steam engines that are required to drive them, those of carbonic acid machines are very much smaller. For small plants the electric motor is frequently mounted on the same bed-plate with the compressor, which it drives through spur gearing, and there is no reason that this should not also be done with large apparatus in the same way as with so many other machines of various kinds. Belt driving, however, has been resorted to a good deal. The smaller refrigerating plants are also often made self-contained; that is, the condenser, the evaporator, the compressor and pumps are arranged in one unit, the condenser and evaporator occupying tanks one inside and insulated from the other, the compressor and accessories being mounted on the outside of the outer tank. The crank shaft is then fitted with a pulley, if a separate drive is intended, or the driving engine is mounted with the compressor on the outside of the outer tank.

WORKING ABSORPTION APPARATUS BY ELECTRICITY.

As has been explained, in the absorption process the ammonia gas is forced out of an aqueous solution by the action of heat. Water dissolves ammonia and other gases in a certain ratio, varying inversely with the temperature. The absorption apparatus, therefore, consists of two vessels, in one of which a strong solution is maintained, from which the gas is being continually driven off; the other, known as the absorber, receiving the gas which has done its work in the evaporator coils and redissolving it. A continuous exchange goes on between the two vessels, the weak solution passing to the absorber and the strong solution passing to the generator. Steam is the heating agent at a temperature of 300 degrees. It appears to the writer to be worth the consideration of electrical engineers, whether it may not be possible to displace steam by electricity. There will be the old objection that has been so often made and in the face of which electricity has made such important progress, that it can not be so economical to use electricity in place of steam when the electricity itself has to be generated by the aid of steam. But it is by no means certain that this expresses the whole of the problem. If the steam passed directly into the aqueous solution it would be correct, but it does not, it passes in pipes through the solution, and only a certain proportion of the heat carried by the steam, and a small proportion at that, passes into the solution, while if the solution were heated by resistance coils, the whole of the heat would pass into it. In addition to this, the use of electricity would avoid one possible source of inefficiency, especially where the machine does not receive careful attention, *viz.*, the leakage of steam into the solution. The absorption apparatus is rendered very much more complicated than it otherwise would be by the fact that when the ammonia gas is driven off some water goes with it, which has to be eliminated before the gas passes to the condenser, and this is increased whenever leaky joints allow steam to escape directly into the solution.

Cement-Covered Wood Poles.

Wooden poles entirely covered with layers of cement one and one-half to two inches thick have been tried in Switzerland with apparent good results. A brief account of some tests with these poles is given in the *Indian Electrical, Mechanical and Textile News* (Bombay), December. It is said that poles of this kind have been in use for three years, and it is hoped that they will prove to be as durable as well-kept iron poles, over which they have the advantage of cheapness. To prepare the pole it is first surrounded by wire netting supported from the pole by iron brackets. Then the whole of the pole is covered with cement to the thickness desired. These poles have been used in lengths of thirty-nine feet, forty-two and one-half feet and forty-six feet. Before adoption a number of tests were made with a thirty-nine-foot pole. These poles have a diameter of from seven to nine inches at the top and twelve and one-half inches at the base. The pole was embedded in the ground to a depth of five feet three inches, and was subjected to a pull thirty-three feet five inches above the ground. This pull was gradually increased until the pole broke, which happened when the strain was 2,370 pounds. Throughout the test the deflections were nearly proportional to the strain. When the pull was 1,860 pounds the deflection was two feet, eleven inches.

The output of aluminum in 1904, according to the report of the United States Geological Survey for that year, recently published, was 8,600,000 pounds. In 1903 the output was 7,500,000 and in 1902 it was 7,300,000. In 1883, its commercial beginning, the output was eighty-three pounds.

SPECIFICATIONS FOR LINE WIRE.[1]

BY F. F. FOWLE.

This paper draws attention to the general purpose of specifications, which are to specify the physical characteristics and properties of the product, to place competitive bids on such a basis that the lowest bidder may be determined and to enable the purchaser to ascertain whether the delivered product meets with the requirements.

The wide range of conditions to be met on railroads, as regards climate and traffic, necessitates specifications covering the properties of wire rather than the specific wire for each case, and dealing rather with methods of construction than details. For this reason it seems better that during the present development of the signal art attention should be paid to standardization of methods in preference to equipment.

The selection of wire for automatic block signals involves the questions of transmission and distribution of power. The vital elements are the cost of power delivered, the amount of power to be transmitted and the distance. These items will vary for different conditions, but a few general principles bear upon all. The cost of the line should be discussed on the basis of the total annual cost rather than the first cost, and this cost is made up of interest, depreciation, maintenance and taxes. The most economical line is that for which the total annual charge, plus the cost of power expended in the line itself, is a minimum.

In choosing a wire for such work the following considerations must be borne in mind: the number of poles per mile, the minimum sag allowed, the weight of the wire and of the insulation per lineal foot, the prescribed maximum sleet load and the maximum wind velocity. Some years ago aerial telegraph lines were built with about thirty poles per mile. The present standard for telephone lines is forty poles per mile, but where severe weather conditions prevail often as many as eighty or ninety are used. The following specifications are taken from those used by the American Telephone and Telegraph Company:

WIRE.

The line wires shall be of hard-drawn copper of the sizes No. 8 B. W. G., No. 12 N. B. S. G., or No. 14 N. B. S. G.

LONG SPANS.

On long spans, three hundred (300) feet or over, the superintendent of construction shall be consulted as to what kind of wire shall be used and the amount of sag that shall be given.

[1] Paper read before the Railway Signal Association, New York, January 9, 1906

METHOD OF STRINGING WIRES.

Wires of the same size shall be pulled up with the apparatus shown in detail in Fig. 1. If six (6) wires are being pulled up, a three (3) sheave block shall be used; if eight (8) wires, a four (4) sheave block; and if ten (10) wires, a five (5) sheave block.

SAG OF WIRES.

The wires shall be strung with a uniform sag so that all the wires on each cross-arm shall be even and level, except where No. 14 wires are on the same arm with No. 8 or No. 12 wires.

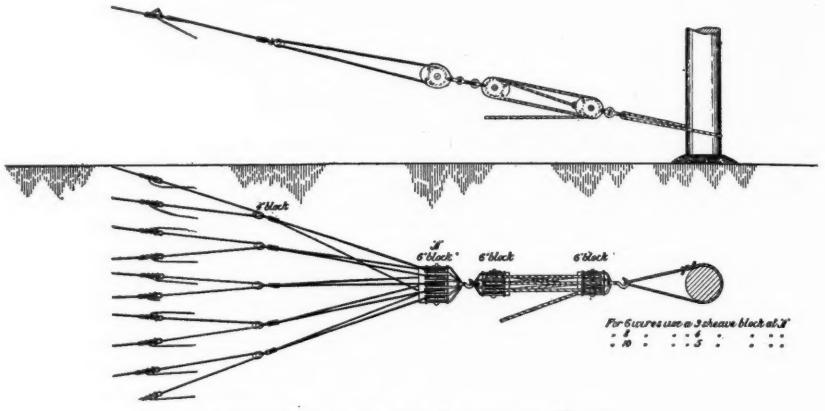


FIG. 1.—APPARATUS FOR PULLING UP WIRES.

No. 8 OR No. 12.

The sag for No. 8 or No. 12 wires shall be as given in the following table, making the allowance therein stated for temperature and length of span.

Temp. Degrees Fahr.	Length of Span in Feet. 75	100	115	130	150	200
	Sag in Inches.					
— 30	1	2	2½	3½	4½	8
— 10	1½	2½	3	4	5	9
+ 10	1½	3	3½	4½	6	10½
+ 30	2	3	4	5½	7	12
+ 60	2½	4½	5½	7	9	15½
+ 80	3	5½	7	8½	11½	19
+ 100	4½	7	9	11	14	22½

No. 14.

The sag of No. 14 wires shall be at least two (2) inches greater than that indicated in the above table for the same temperature and span.

LOCATION OF WIRES.

On straight lines the wires shall be tied to the insulators in the position shown at "A," Fig. 2. On curves and corners the wires shall be tied to the insulators in the position shown at "B," Fig. 2.

METHOD OF TYING WIRES.

The line wires shall be tied to the insulators in the manner shown in Fig. 3. It will be noticed that one side of the tie wire passes over the line wire and makes five (5) complete turns, and the other side passes under the line wire and makes five (5) complete turns.

JOINTS.

The joints in the copper wires shall be made with "McIntire" sleeves.

STANDARD SLEEVE.

Each standard sleeve for No. 14 N. B. S. G. or No. 12 N. B. S. G. shall have four (4) complete twists; each standard sleeve for No. 8 B. W. G. shall have four and one-half (4½) complete twists.

REGULAR SLEEVES.

With the regular "McIntire" sleeve, each sleeve for No. 14 N. B. S. G. or No. 12 N. B. S. G. shall have three (3) complete twists; each sleeve for No. 8 B. W. G. shall have three and one-half (3½) complete twists.

DEAD ENDING.

Where it is necessary to dead end a line, as at a point where a run-in is to be made to an office or cable, the wire shall be attached to the insulator, as shown in Fig. 4, and fastened with a half sleeve. One and a half twists shall be given the half sleeve.

The table of sag, it will be noticed, covers conditions of temperature and span very thoroughly. One of the points to be especially noted is the increased sag given to No. 14 N. B. S. G. The following is taken from the American Telephone and Telegraph Company's specifications for hard drawn copper wire:

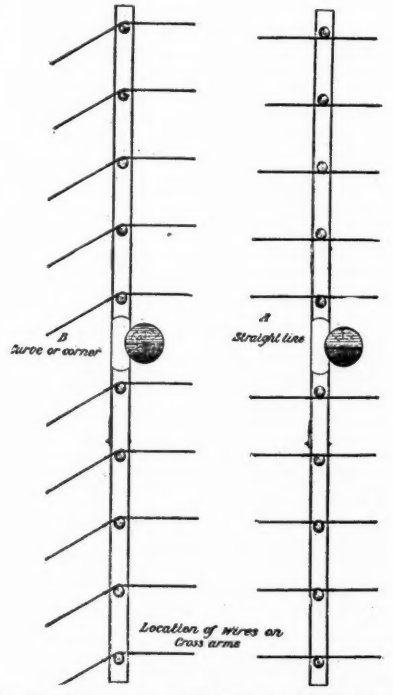


FIG. 2.—LOCATION OF WIRES ON CROSS-ARMS.

MANUFACTURE.

The copper bars before rolling shall be entirely free from defects. Each coil shall be drawn in one continuous length and shall be free from factory joints.

FINISH.

The wire shall be uniformly cylindrical

in form and free from scales, inequalities, flaws, splints, and all other imperfections.

MECHANICAL AND ELECTRICAL REQUIREMENTS.

Gauge Number.	Diameter of Wire in Inches.			Weight per Mile in Pounds.	
	Required.	Maximum.	Minimum.	Maximum.	Minimum.
16 B. W. G.	.0650	.0655	.0645	68.8	66.7
14 N. B. S..	.0800	.0805	.0795	103.9	101.3
12 B. & S ..	.0808	.0813	.0803	106.0	103.4
13 N. B. S..	.0920	.0926	.0914	137.5	133.9
12 N. B. S..	.1040	.1047	.1033	175.7	171.1
10 N. B. S..	.1280	.1288	.1272	265.9	259.4
10 B. W. G.	.1340	.1349	.1331	291.7	284 0
8 B. W. G.	.1650	.1660	.1640	441.7	431.1

TENSILE STRENGTH.

Gauge Number.	Pounds per Square Inch, Minimum.	Minimum Breaking Weight for Required Diameter.	Percentage Elongation in Five Feet, Minimum.	Conductivity in Per Cent of Pure Copper, Minimum.
16 B. W. G .	66,200	220	.91	96
14 N. B. S ..	65,600	330	.94	96
12 B. & S ...	65,500	336	.95	96
13 N. B. S ..	65,100	433	.97	96
12 N. B. S ..	64,600	549	1.00	96
10 N. B. S ..	63,700	820	1.06	96
10 B. W. G .	63,400	894	1.07	96
8 B. W. G .	62,108	1,328	1.14	96

The weight in pounds per mile is found by multiplying the square of the diameter of the wire in inches by the constant number 16030.[1]

REMOVAL OF ENDS.

To ensure the removal of defects from the wire, the manufacturer shall cut off at least twenty-five (25) feet of wire, or as

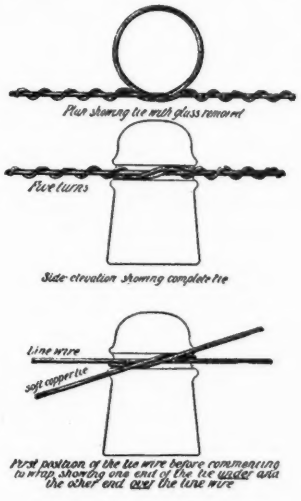


FIG. 3.—TYING THE WIRE.

much more as may be necessary, from each end of every coil.

COILS.

Unless otherwise specified by the telephone company, the weights of the coils shall lie within the following limits:

Gauge Number.	Weight of Coil in Pounds. Maximum.	Minimum.
16 B. W. G.....	50	32
14 N. B. S..... ...	72	53
12 B. & S	72	53
13 N. B. S.....	136	67
12 N. B. S.....	218	97
10 N. B. S	218	152
10 B. W. G.....	218	152
8 B. W. G.....	218	152

The diameter of the eye of the coil shall, in every case, be not less than twenty (20) inches or more than twenty-two (22) inches.

[1] Based on specific gravity for hard-drawn copper wire 8.92.

The following are the specifications for weatherproof wire used by the American Telephone and Telegraph Company:

GENERAL DESCRIPTION.

The finished product desired under these specifications consists of hard-drawn copper wire, covered with a weatherproof braid, as hereinafter specified.

CONDUCTOR.

The copper bars, before rolling, shall be entirely free from defects. Each coil of wire shall be drawn in one continuous length, and shall be free from factory joints. The conductor shall be uniformly cylindrical in form and free from scales, inequalities, flaws, splints and all other imperfections.

REMOVAL OF ENDS.

To ensure the removal of defects from the wire the manufacturer shall cut off at least

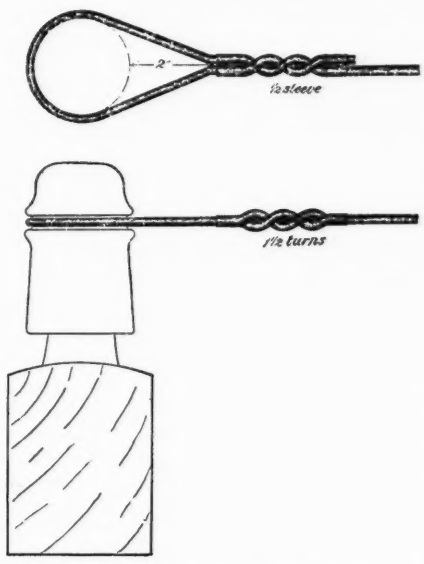


FIG. 4.—METHOD OF DEAD-ENDING.

twenty-five (25) feet of wire, or as much more as may be necessary from each end of every coil.

COVERING.

The conductor shall be covered with not less than three (3) close braids of cotton or other approved material. This braided covering shall be saturated with a permanent weatherproof compound that shall be insoluble in water. The compound shall not melt or crack when subjected to a temperature of seventy degrees (70°) above and below sixty degrees Fahrenheit.

The mechanical and electrical properties presented are identical with those for bare wire.

The tests shall be made on samples from which the covering has been removed.

The wire shall be furnished in coils of such dimensions as may be specified by the telephone company.

The insulation on a wire is of value chiefly in case of accidents. The objections to it are that its life is less than that of copper and the mechanical properties are indefinite. The insulation most usually employed is a double braid of cotton saturated with a weatherproof compound. Rubber is sometimes used, covered with braid, but its value as an insulator is, in this case, nil. Where additional strength is required triple braid is better.

New York Electrical Society.

Mr. R. T. Lozier will lecture before the New York Electrical Society at the Edison Assembly Room, 44 West Twenty-seventh street, New York city, Wednesday evening, February 21, on "Fundamental Principles of Gas Engines and Gas Producers." The lecturer will take the subject from the sphere of the steam engine and boiler to that of the gas engine and producer, giving analyses of the gases used and the products of combustion, the distribution of losses and noting the best points in modern practice.

National Electric Light Association.

The annual convention of the National Electric Light Association will be held at Atlantic City, N. J., June 5 to 8, inclusive. The meeting hall will be the small auditorium of Young's Pier. At the front of the pier is a large exhibition room, which has been secured for the exhibits of the associate members. The present plans contemplate opening the exhibition on Monday, a reception and ball on Tuesday and a banquet on Thursday.

The Rejuvenated Sons of Jove.

On January 26, during the electrical show at Chicago, a rejuvenation of the Sons of Jove took place in the Coliseum, the Jovian parade being enjoyed by many of the visitors to the show. On the same evening there was conducted the initiation of over 100 electrical manufacturers, supply dealers and contractors. The different offices were represented during the ceremony of initiation as follows: Jupiter, James Wolff; Pluto, S. A. Bouslog; Vulcan, J. H. La Roche; Neptune, S. A. Rall; Mercury, C. B. Roulet; Mars, L. Clark; Hercules, J. A. Campbell; Apollo, S. R. Fralick; First Imp, P. T. Lyons; Second Imp, F. F. Skeel; Avrenim, George MacElwee.

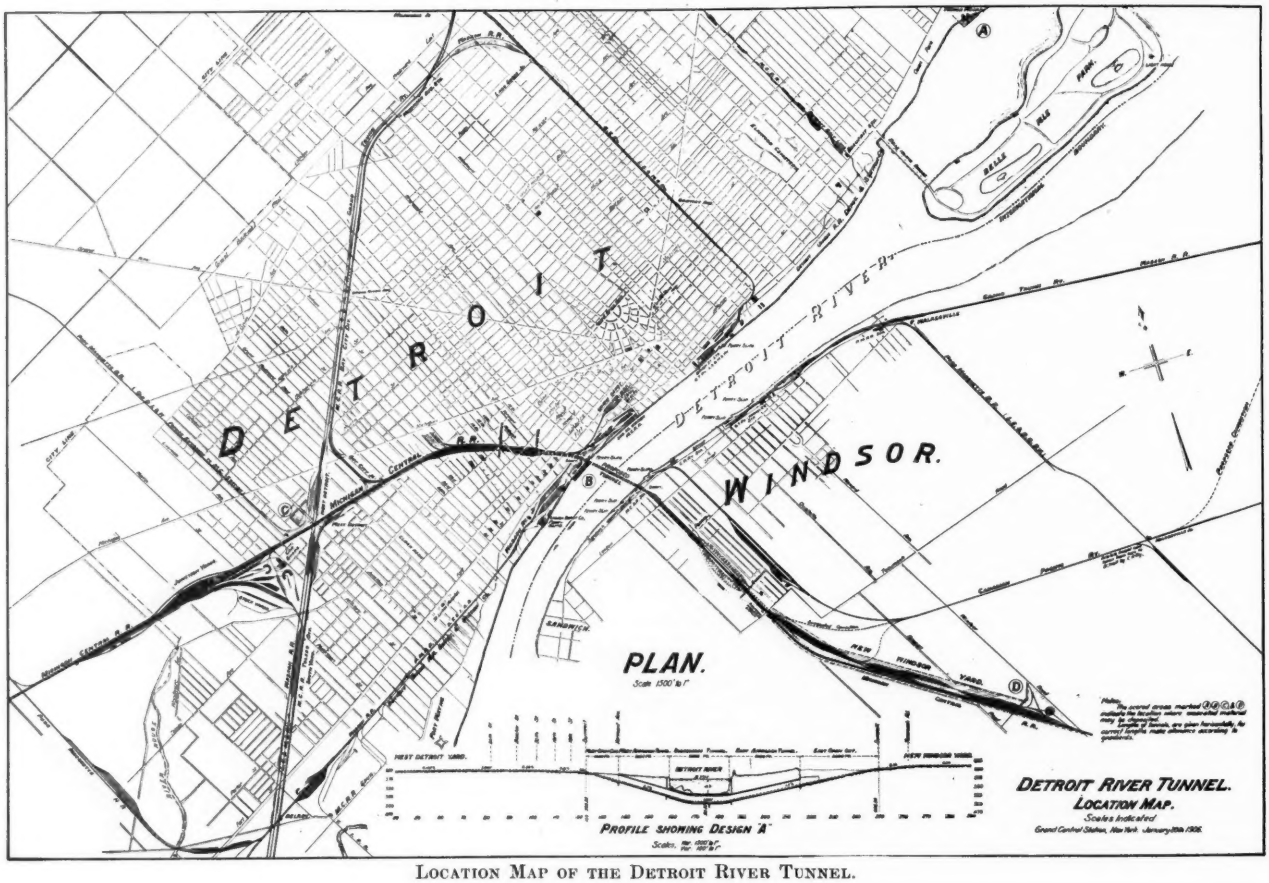
Westinghouse-Allis-Chalmers Turbine Suit.

The Westinghouse Machine Company, Pittsburg, Pa., has filed a bill of complaint against the Allis-Chalmers company, Milwaukee, Wis., alleging that the latter company has incorporated in its turbines patented improvements owned by the Westinghouse company. The Westinghouse Machine Company in 1895 purchased from Charles A. Parsons, the inventor, and his associates the American patents, and, it is understood, contracted for all rights covering improvements that Mr. Parsons or his associates might make during a term of years. The Allis-Chalmers company made a later arrangement with Mr. Parsons, which it contends covers the later inventions and improvements.

The Proposed Tunnel Under the Detroit River.

The Michigan Central Railroad at present crosses the Detroit river from Detroit to Windsor by means of a ferry. It is now proposed to construct a tunnel under the river so as to avoid the delays and inconveniences of the present method. For this purpose a company known as the Detroit River Tunnel Company has been formed and has issued plans and specifications for the proposed work. These have been prepared under the direction of an advisory board of engineers, which consists of W. J. Wilgus, chairman; H. A. Carson and W. S. Kinnear. The proposals for the construction of the tunnel will be received until March 8, 1906.

The tunnel will connect Detroit, Mich., with Windsor, Ont., passing under the bed of the river. It will consist of two single-track tubes side by side, with the necessary approaches at each end. The sub-aqueous tunnel will be about 2,625 feet in length; the easterly approach tunnel in Windsor will be about 3,100 feet long and will have a grade of one and one-half per cent. The approach to this tunnel will be by means of an open cut 3,400 feet in length. On the westerly bank of the river the approach tunnel will have a length of about 2,130 feet with a grade of two per cent. The open cut on this side will be approximately 1,540 feet in length. The total length of the tunnel, including the two approach tunnels, will be about 7,850 feet, while the length of the tunnels and approaches will be about 12,800 feet. The accompanying map shows the location of the tunnel and the approaches. It is purposed to draw the trains through this tunnel electrically, though the plans for this part of the work are not yet complete. The electrical zone will include the approaches to the tunnel at each side, making about four miles of electrically operated road.



LOCATION MAP OF THE DETROIT RIVER TUNNEL.

Bids are asked upon four alternative plans for the tunnel. These plans vary somewhat, though the greatest difference is in the method of construction. The sub-aqueous tunnels will have a circular cross-section about eighteen feet in diameter. The height from the head of the rails to the top of the tunnel will be sixteen feet. The tunnel will be lined with reenforced concrete, surrounded with a concrete tube, which will, in turn, be surrounded by concrete filling. Benches along the sides of the tunnel will contain the conduits for the power circuits and for the telephone, telegraph, light and signal wires. The approach tunnels will be constructed of concrete reenforced by longitudinal and transverse rods.

The four types of sub-aqueous tunnel are designated as "A," "B," "C" and "D." Design "A" is described briefly as a method by which the pervious material underlying the river is replaced by an imperfectly water-tight material of concrete placed under water, through which, without the use of shields, the inner tubes or tunnel proper may be constructed so as to secure water tightness, continuity of strength and good workmanship, with an absence of high air pressure. This plan dispenses with the use of coffer dams. The various stages in the work are, first, the dredging of a trench of the approximate dimensions required for the tunnel. Within this trench stone will be deposited for a depth of eighteen inches on the bottom of the trench. Upon the stone will be deposited a layer of concrete approximately two feet thick. On this bed will be placed saddles for supporting forms, which will be constructed on shore and floated into position and then sunk upon the saddles. Around and over these forms concrete will be laid, either directly in the water or in bags, so as to form an imperfectly water-tight layer. After the concrete is

set the water will be pumped out of the tunnel a section at a time and the work of erecting the water-tight shield will be begun. The forms which are to be sunk upon the saddles may be either of wood or of rolled steel.

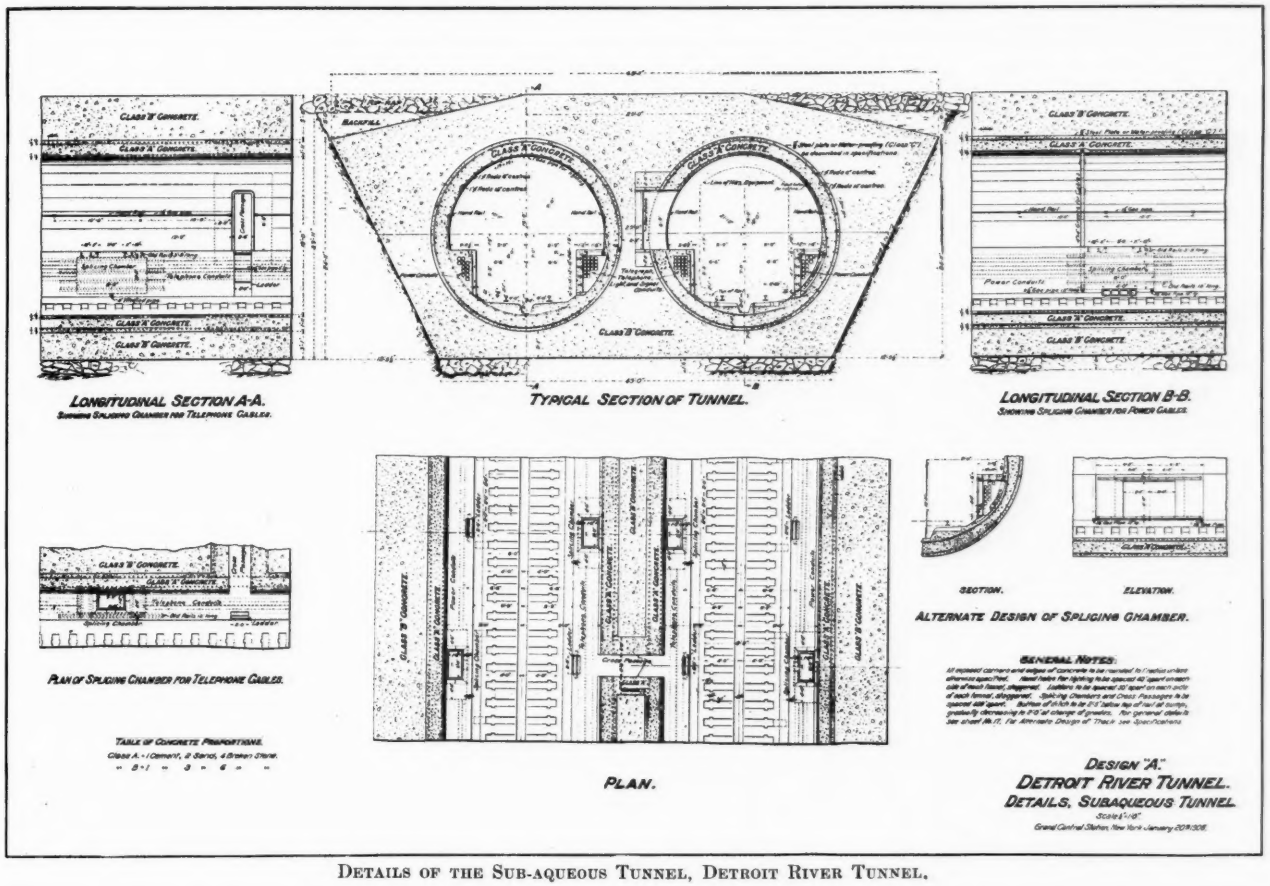
Design "B" is a method by which the inner tubes of the tunnel proper are built in floats or on dry land and floated and sunk into position on the proper foundations. These tubes will then be joined together so as to make a water-tight connection. The stages of construction are, first, the dredging of a trench, the laying of stone along the bottom and then a two-foot bed of concrete, upon which saddles will be placed, as in the preceding design.

The fourth design, designated as "D," is of the shield-driven method. Since the summits of the two tunnel gradients cause the location of the top of the tunnel for the sub-aqueous section close to the river bed, artificial filling-in will have to be resorted to, if this method of construction is adopted, in order to hold the air which is employed in this method. For this purpose temporary blankets or masses of clay will have to be laid on the top of the location of the tunnel.

In order to make the tunnel entirely water tight, a waterproofing will surround the exterior of the structure. This will consist of several alternate layers of felt dipped in pitch, and of pitch.

The Report of the President of the Cuyahoga Telephone Company.

The report of Frederick S. Dickson, president of the Cuyahoga Telephone Company, Cleveland, Ohio, for the year 1905, to the stockholders, shows that during the year some $719,502.14 was spent in the development of the plant. This expenditure made possible the addition of 6,070 telephones to the system and added six sections to the central exchange switchboard. The total installation in cables during the past twelve months was 10,195 miles of wire. In addition, there were strung 2,114.1 miles of outside wire and 152.5 miles of inside wire—a total of 12,-461.6 miles of copper wire. On Decem-



DETAILS OF THE SUB-AQUEOUS TUNNEL, DETROIT RIVER TUNNEL.

The tubes will then be floated into position and sunk to a proper bearing upon the saddles. Concrete will be distributed around the tubes.

The third design, "C," is practically the same as "A," with the exception of a certain style of steel form and arrangement of reenforcing, in which this differs from the other. The tubes for these two designs consist of concrete reenforced with steel rods where necessary. This lining is to be laid continuously, so that with the aid of the metal reenforcements the inner tube will be homogeneous and of uniform strength from end to end.

The ducts for the cables and wires are to be constructed of vitrified clay and will consist of single-way forms having holes three and one-half inches square. These ducts are to be laid in beds of cement mortar with broken joints, the joints being covered with muslin, and due care being taken to see that they are in line.

The contractor, if he prefers, may suggest an alternative method of constructing the tunnel which may seem to him more suitable than those described. The tunnel must, however, conform to the grades and depths as laid out in the plans.

ber 31, 1904, the total number of telephones in service was 14,454. On December 31, 1905, the total number was 20,-440. On December 31, 1904, there were 493 pay stations, the receipts amounting to $20,170.75. On December 31, 1905, there were 725 pay stations, the receipts amounting to $33,735.16.

The gross earnings for 1905 were $29.99 a telephone. The expenses and taxes were $15.60 a telephone. The net earnings for each telephone were $14.39, with other income of eleven cents a telephone, making the net income $14.50 a telephone. From this was deducted $6.87 a telephone, leaving a surplus of $7.63.

Warren & Jamestown Single-Phase Railway.

The electric railway which has recently been opened between Warren, Pa., and Jamestown, N. Y., traverses the valley of the beautiful Conewango creek and connects the rich "Tiona" oil fields of Pennsylvania with the southern shore of the lake. Warren, the southern terminal of the line and headquarters of the operating company, is located at the junction of the creek and the river, in the heart of the oil fields and within a natural gas belt, containing some 15,000 people, while its surrounding territory has a population of 10,000 more within easy access of the new road. Jamestown, at the other end, is a prosperous manufacturing city of 29,000 inhabitants, connected by steam and electric roads with the attractive resorts of the Chautauqua region, whose summer population is estimated at 50,000. The New York towns of Falconer, Frewsburg and Fentonville, and Ackley, Russell and Glade, Pa., with their surrounding neighborhoods, bring the total permanent population of the territory adjacent to the new railway to upward of 65,000 inhabitants.

The equipment is thoroughly modern, comprising horizontal gas engines as prime sources of driving power, and the single-phase alternating-current system of the Westinghouse Electric and Manufacturing Company.

Seventy-pound rails are laid on ties of oak and chestnut and ballasted with gravel. They are connected by the type G, form 2, soldered bonds of the Ohio Brass Company, and are cross-bonded at frequent intervals.

The car barns are at Warren, Pa., and Frewsburg, N. Y., the repair shop being in the former.

The power-house is located at Stoneham, five miles south of Warren, that site having been selected by reason of its proximity to the natural gas pipe lines from which its fuel supply is obtained. The equipment includes two 260-kilowatt, 380-volt, twenty-five-cycle, alternating-current generators of the revolving field type which are direct-connected to horizontal gas engines operating at a speed of 150 revolutions per minute. The two units are connected in parallel and run together with remarkable smoothness. The engines were constructed and erected by the Westinghouse Machine Company, and the electrical machinery was furnished and installed by the Westinghouse Electric and Manufacturing Company.

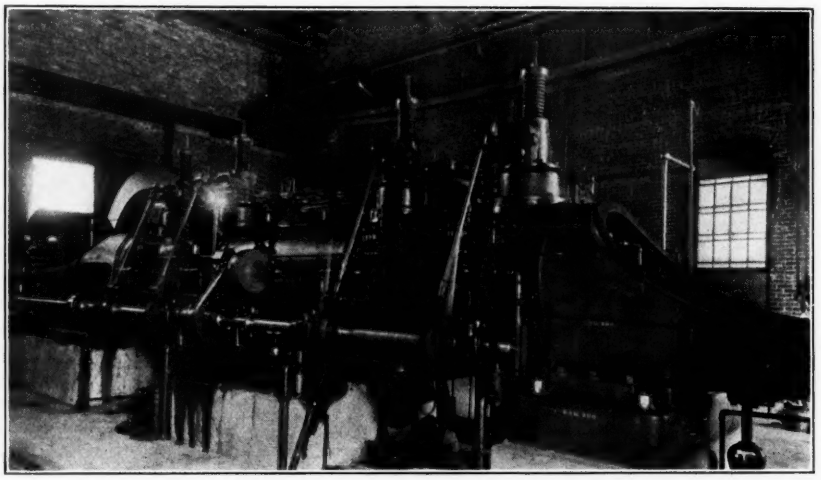
In the new type of horizontal double-acting gas engine, the first representatives of which are now operating at Warren, the builders have especially sought to construct a prime mover best suited from all standpoints to the American market.

There are two main generating units at present installed at Warren, with space for a third of equal size. Single-crank tandem units were employed in place of twin-tandem units in order to give greater flexibility of operation, the former representing the standard adopted by the builders. The units have solid couplings between engine and generator and operate in parallel on the station load in precisely the same manner as ordinary steam-driven units. The familiar Beau de Rochas or four-stroke cycle is used, which, with the tandem arrangement, gives a power impulse with each successive stroke of the engine. Cylinders are twenty-one inches in diameter by thirty-inch stroke, the unit running at a nominal speed of 150 revolutions per minute. For this particular service the engine is rated at 470 brake-horse-power, with a maximum of 520 brake-horse-power, giving a thirty-five per cent overload capacity on the generator. The details of these engines will be described in a later edition of this journal.

The Warren plant was started on October 19, 1905, and has since been in continuous service, averaging seventeen and one-half to eighteen hours per day without developing the least trouble of a serious nature. The only prolonged shutdown was made after a two months' run for the purpose of examining the condition of the interior of the first unit started. Every part was found to be in perfect working order without the least evidence of deterioration from wear or excessive strains.

Daily observations of the gas consumption of the plant furnish a striking indication of high economy. During the month of December, 1905, the cost of gas consumed by the interurban system averaged less than fifty cents per hour, or about sixteen cents per car-hour for thirty-five-ton interurban single-phase cars. At present the large gas engines operate both interurban and city systems, totalling ten cars. During the week ending January 12 the cost of gas averaged less than seventy-five cents per hour or seven and one-half cents per car-hour for three interurban and seven city cars.

From the generators the current passes through a switchboard of blue Vermont marble panels completely equipped with apparatus and controlling devices to raising transformers of the Westinghouse oil-immersed, self-cooling type, which transform the potential from 380 to 22,000 volts. The two feeders which leave the station are adequately protected by circuit-breakers of the fuse type, disconnecting switches, low-equivalent lightning arresters and choke coils.

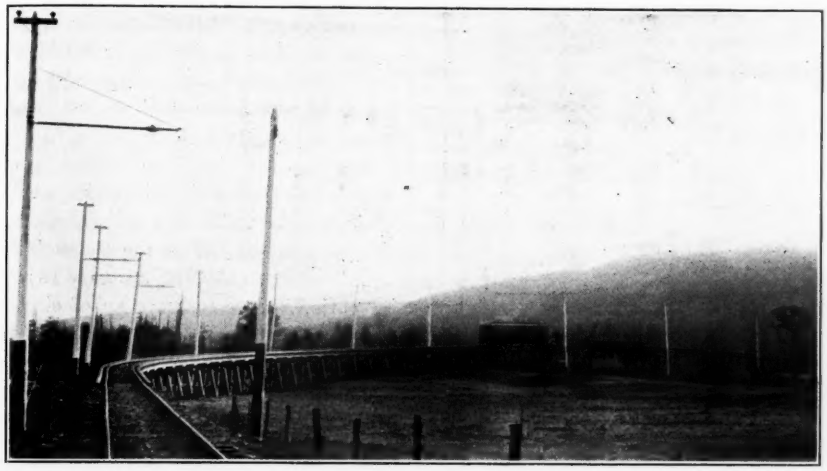


GAS ENGINE OF THE TYPE INSTALLED AT THE POWER-HOUSE OF THE WARREN & JAMESTOWN STREET RAILWAY.

The high-potential lines of No. 6 bare copper wire are carried on porcelain insulators of the Ohio Brass Company, known by the trade name of Locke No. 406, which are supported on chestnut poles. Each feeder connects with a transforming station, one of which is located one and one-quarter miles from the Warren terminal and the other one and one-half miles from the end of the line in Jamestown.

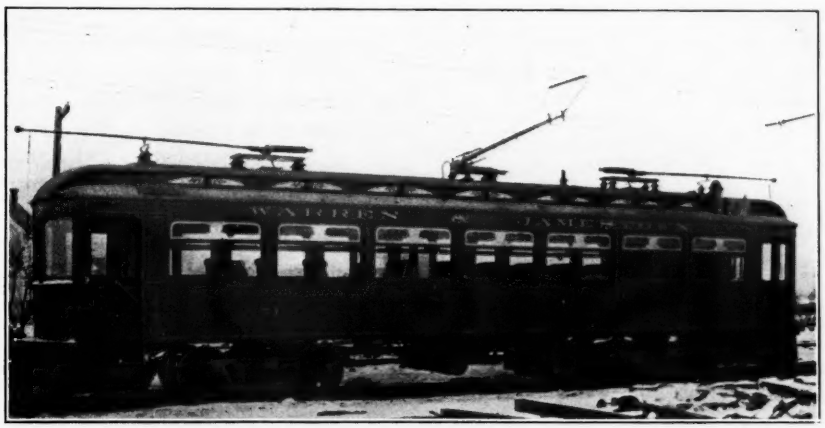
The transformer stations are made of concrete blocks and are of suitable size to permit a wise arrangement of the apparatus. They are similarly equipped, each containing two 150-kilowatt, 22,000-3,300-volt, lowering transformers of the oil-immersed, self-cooling type, which are controlled and protected by fuse-type circuit-breakers and disconnecting switches in the high-potential circuits and by oil switches

and enclosed fuses in the secondary lines, one of which taps the 3,300-volt trolley section, while the other feeds the city section of the trolley line through auto-transformers along the track, which reduce the potential from 3,300 to 550 volts. Both high and low-potential feeder circuits are protected by choke coils and low-equivalent lightning arresters which are



CURVE AND TRESTLE, SHOWING CATENARY CONSTRUCTION OF OVERHEAD LINE.

mounted in the transformer stations. The apparatus is symmetrically arranged, that mounted on one side of the station being exactly duplicated on the other. The two transformers are connected in parallel. Each has sufficient capacity to carry the entire normal load and either may be readily cut out of service. The transformer stations are operated entirely without attendants, and require only occasional inspection.



PASSENGER CAR, SINGLE-PHASE EQUIPMENT, WARREN & JAMESTOWN STREET RAILWAY.

The trolley line is divided into a central and two terminal sections. The central section is connected direct to the transformer stations receiving alternating current at 3,300 volts. A No. 000 figure-8 trolley wire is swung by catenary suspension from a seven-sixteenths-inch messenger cable which is carried on heavy porcelain insulators mounted on angle-iron brackets supported on the chestnut poles. The poles measure seven inches at the top and are thirty-five feet long.

The overhead construction is particularly fine, as may be seen by reference to the illustrations. A nice detail is the slight raising of one trolley wire at switch turn-outs, so that the bow trolley easily passes from one wire to the other without impairment of contact. The catenary overhead line construction is thoroughly substantial and reliable, and has not given the slightest trouble since erection. The central high-voltage trolley line is separated from the terminal sections by section insulators.

Within the limits of the terminal cities the trolley lines are supplied with alternating current at the low potential of 550 volts. A feeder from each transformer station leads to three seventy-five-kilowatt autotransformers which are located along the track and connected to a No. 0000 secondary feeder which supplies the trolley.

The low-potential trolley line is supported from span wires by insulating hangers, in accordance with the practice standard for direct-current work. In Warren the new cars run over the tracks of the Warren Street Railway Company, which is equipped with the direct-current system. The two trolley wires, alternating- and direct-current, are suspended side by side from the same spans without appreciably complicating the structure or in any way impairing the service of either system.

The operating company has at present five passenger cars and one baggage car, all of which were furnished by the St. Louis Car Company. Each is equipped with four Westinghouse No. 108 fifty-horse-power motors of the single-phase, alternating-current, compensating, series type, mounted one on each axle and connected by single reduction gears. The motors are connected permanently in multiple and are operated by the hand-control system by means of taps from an auto-transformer which supplies a varying electromotive force at the motor terminals.

The bow trolley is used on the 3,300-volt section, the wheel trolleys on the terminal sections of the line. A change-over switch is arranged to cut out the bow trolley and transfer the connections of the wheel trolleys from the low to the high-voltage service taps of the autotransformer, so that, in case of accident to the bow trolley, the wheel trolleys, which are mounted on heavy insulators, may be used on the 3,300-volt section of the line. The bow trolley is pneumatically operated, the controlling valve being mounted on the platform within easy reach of the motorman. Preventive coils and resistances eliminate arcing at the controller contacts when passing from one transformer connection to another.

The cars are equipped with Westinghouse straight air brakes operated by means of an air compressor, which is driven by a single-phase, series-wound motor of a construction similar to that employed for the main driving motors. Hand brakes are also supplied. The car, complete with equipment but without load, weighs approximately 66,000 pounds.

The maximum running speed is fifty miles per hour. The complete run from terminal to terminal without stops has been made in forty-seven minutes.

The present service of the Warren & Jamestown Street Railway Company requires a total of but eight employés, outside of the general offices and the car crews:

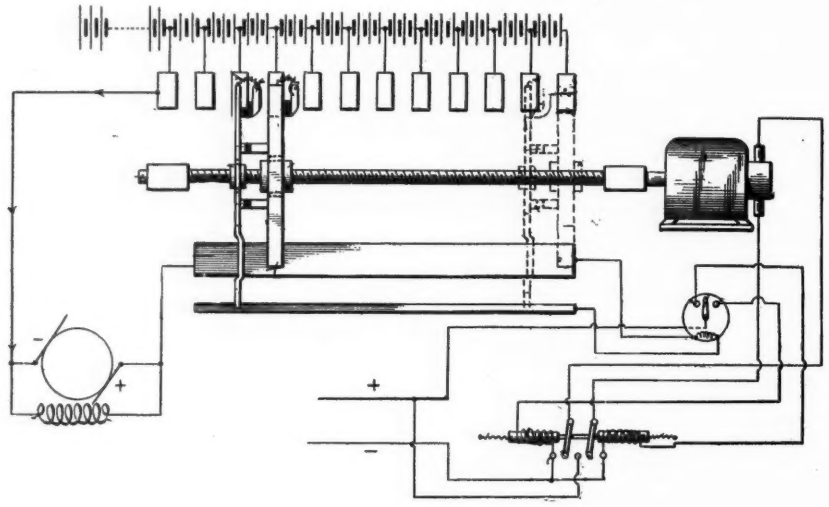
The officers of the company are:

D. H. Siggins, president; H. M. Preston, vice-president; S. Q. Smith, secretary.

Mr. Siggins is assisted in the management of the property by his son, H. A. Siggins, a director of the company and general manager of the Warren Street Railway.

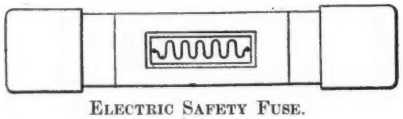
Electrical Patents.

Lamar Lyndon, New York, N. Y., has obtained a patent (810,958, January 30) on an improved end-cell switch, and he has assigned this to the General Storage Battery Company. This invention relates to end-cell switches for storage batteries, and the object of the invention is to enable the end cells to be automatically charged as necessary for the needs of the system in which the storage battery is used. The invention consists in the combination with the end cells of a storage battery, of reversible charging means having a switch brush, circuits and connections for automatically controlling the charging means solely in accordance with the electric condition of the end cells, whereby the brush is moved in either direction, and means for automatically determining the position of the brush in accordance with the electric condition of the end cells.



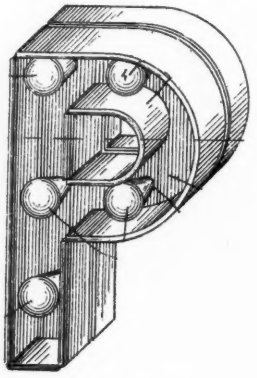
End-Cell Switch.

Elmer L. Ogle, of Peru, Ind., has obtained a patent (809,978, January 16) for an improved electric safety fuse, assigning it to the Peru Electric Manufacturing Company. The invention relates to an improvement in the class of enclosed electric fuses or cutouts, and consists in providing such a fuse with means for indicating its condition merely by visual inspection, means for protecting the heat-affected medium and also to an improvement in the filling or packing material as well as to means incorporated with the shell, whereby provision is made for the escape of the gases in case of blowing out. An electric fuse consisting of an enclosing-case provided with a main fuse connected with the terminals of the case, an auxiliary fuse connected to the main fuse, a layer of paper saturated in a sensitive chemical material adapted to be discolored upon blowing of the fuse, the auxiliary fuse being in contact therewith, and a covering of transparent material, with an outer wrapping device having a corresponding sight-opening.



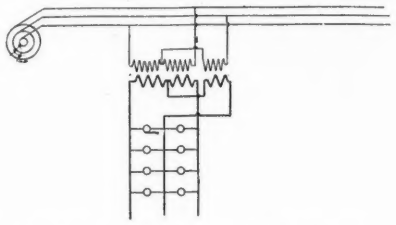
Electric Safety Fuse.

Carl Haller, Chicago, Ill., has obtained a patent (811,058, January 30) for an improved electric sign. The invention relates to electric signs of the type wherein the sign letters or numerals are illuminated by incandescent electric lamps, and the purpose is to provide an individual sign-letter—that is to say, a letter or numeral which is complete in itself and which need not be secured to any foundation plate or similar structure in order to be complete. With this purpose in view the general object of the invention is to produce a letter which is simple in construction, durable, waterproof, capable of exhibiting a sharp line and efficient only when a comparatively small number of lamps are employed. The novelty claimed for this invention resides more especially in the formation of the walls of the letter-shells, the diaphragms and its manner of mounting, and the location of the lamp-sockets upon the back-plates. In an electric sign a one-piece sheet-metal letter-outline shell, having a ridge formed therein and stiffened in front by a beading formed therein, in combination with lamp sockets, and a diaphragm adapted to fit within the shell against the said ridge and substantially cover said sockets.



Electric Sign.

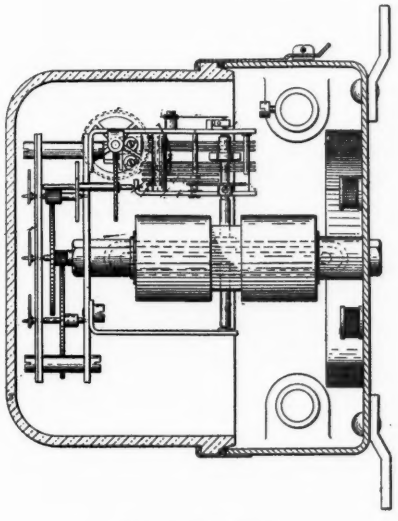
An improvement in a system of electrical distribution has been invented by Charles P. Steinmetz, of Schenectady, N. Y., assigning it to the General Electric Company (809,996, January 16). The invention relates to a system of electrical distribution for polyphase currents of such nature that three-phase and quarter-phase currents are rendered convertible. In other words, a three-phase system in which the currents are one hundred and twenty degrees apart in phase may be converted into a quarter-phase system in which the currents differ by ninety degrees in phase, or, conversely, quarter-phase currents may be converted into three-phase currents. The invention consists in the combination of a main transformer and a supplementary transformer connected to the main transformer at a point dividing the electromotive force of the main transformer into two substantially equal parts and so proportioned that the resultant electromotive forces generated in the supplementary transformer and the respective halves of the main transformer are substantially equal to that of the main transformer.



System of Electrical Distribution.

William Stanley, of Great Barrington, Mass., has obtained a patent (809,995, January 16, 1906) for an improved electric meter. This invention relates to electric meters and has for its object to produce a meter of the oscillating type in which the record of the number of oscillations shall indicate the current that is consumed by the translating device. The meter is capable of being used to measure alternating as well as continuous cur-

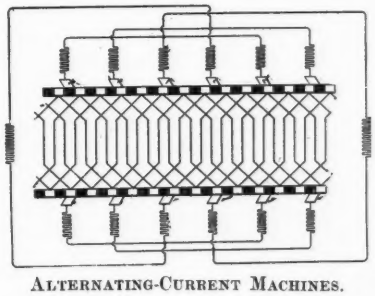
rents and has no dead point, so that it is self-starting under all conditions. The operation of the meter depends upon the fact that a magnetic needle when subject to the influence of a magnetizing coil will oscillate at a rate inversely proportional to the field in which the oscillations take place, frictional resistance being slight and the inertia of the moving system being comparatively great. If there were no frictional resistance retarding the moving system and tending to reduce the amplitude of the oscillation, such a needle, if once started, would forever oscillate with a frequency of $T = \frac{1}{F}$ where T equals the time of oscillation and F equals the number of lines of magnetic force at right angles to its axis. In practice, however,



ELECTRIC METER.

unless an added impulse is given from time to time the friction will cause it to come to rest. In the present invention there is provided a novel means for compensating for the retardation due to friction, such means consisting of an auxiliary coil whose axis is at an angle to the axis of the main magnetizing coil and devices for energizing the auxiliary coil periodically, so as to periodically impress upon the needle an added force or impulse of such value as will be sufficient to balance the retarding effect of the frictional resistance. Preferably the auxiliary coil is energized alternately in opposite directions so as to impress such a force or impulse upon the needle during its movement in each direction. The number of oscillations taking place is recorded by a suitable indicating mechanism, the record of which will truly indicate the strength of the main field, determining the time of oscillation of the needle and consequently the strength of the currents producing such a field.

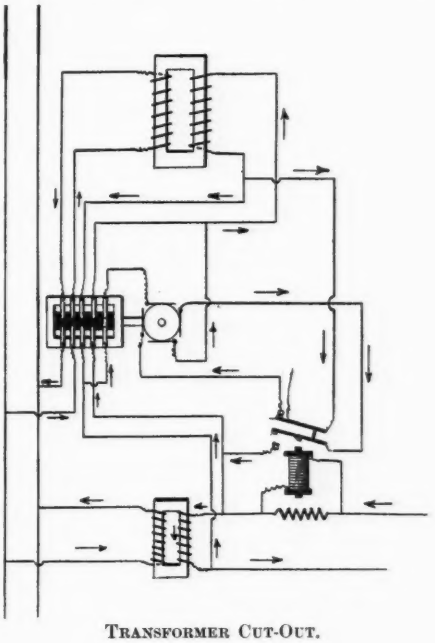
Marius Latour, Paris, France, has obtained a patent (811,304, January 30) on an improved alternating-current machine, assigning it to the General Electric Company. The invention relates to alternating-current machines of the commutator type; and its object is to provide novel commutating means for such machines whereby sparking at the commutator is eliminated. It is a well-known characteristic of the series or wave-winding that only a single pair of brushes is required for a multipolar machine, since all of the armature winding is in series. The inventor takes advantage of this fact by providing a commutator having alternate live and dead segments and employing a plurality of brushes of each polarity distributed around the commutator of a width



ALTERNATING-CURRENT MACHINES.

no greater than that of a commutator segment. If only a single pair of brushes were used the armature circuit would be opened every time a dead segment passed a brush, but by employing a second set of brushes, connected in parallel with the first, and so arranging the second set that they are in engagement with live segments at the instant that the first set are in engagement with dead segments, he maintains the armature circuit always closed, although the circuit of each brush is continuously opened and closed. With the arrangement, as outlined above, it is evident that no short-circuit can be produced by a single brush, since no single brush is wide enough to engage two live segments at the same time; consequently, the inventor claims, no short-circuits can exist within the machine.

An improvement in transformer cut-out has been invented by John P. Hetherington, of Logansport, Ind. (809,302, January 9, 1906). This invention relates to systems of electrical distribution wherein transformers are employed to reduce the potential to a voltage desirable for use. As is well known, in all such transformers there is a constant core loss, and hence for this, as well as for other reasons, it is desirable to eliminate the effect of unnecessary transformers from the system. It is the object of the present invention to cut out automatically all multiple or assisting transformers from the circuit when not needed to assist in transforming current and to replace them in the circuit when needed, leaving the first transformer of a set in circuit all the time. The invention employs means for automatically introducing an auxiliary transformer into the system in parallel with the main transformer and cutting it out therefrom. The means consists of connections from the primary to the auxiliary transformer and from the latter to the secondary circuit, a switch for controlling the connections, a motor for operating the switch, a magnet inter-



TRANSFORMER CUT-OUT.

posed in the secondary circuit, an armature carrying electrical connections and contact-points upon its opposite sides and adapted to be actuated by the magnet upon an excess of load in the secondary, contacts adjacent at the side of the armature and adapted to be engaged by the contact-points upon the armature.

By means of what is known as the phonocard it is now possible to transmit the human voice by post. The phonocard is prepared in the same way as an ordinary phonographic record. A substance known as sonorine is spread on a sheet of cardboard, and on this the record is made by speaking into the phonograph. The sounds are thus inscribed in a spiral beginning on the outside of the card and finishing in the centre. Some seventy or eighty words can thus be inscribed on a postcard. The receiver of the card has merely to put it into a phonograph and listen to the voice of the sender.

Reviews of Current Engineering and Scientific Literature.

A System of Connection for Multiple Telegraphic or Telephonic Communications.

A system of multiple communication either for telephone or telegraph has been devised by Herr O. Arendt, of Berlin, Germany, and is described briefly here by Dr. Alfred Gradenwitz. It consists essentially of coupling in the transmission circuits induction coils, wound so that the current flowing through any one pair of lines will neutralize the action of the coils in that line, but will be opposed by the inductance of the coils in the other lines. By properly grouping a number of such coils and a similar number of lines, as many complete circuits can be obtained as there are pairs of lines, and each circuit can be used at any time without respect to the use of any other. Each coil has on it two windings, arranged so that when a current passes through the two windings in opposite directions the inductance is negligible, but when the current passes through either one of the windings it is opposed by the full inductance of the coil. By a modification of the system the ground may be used as one of the lines.—*Abstracted from the American Telephone Journal (New York), February* 3.

Producer Gas for Electric Power Stations.

It is thought by Mr. Samuel S. Wyer that the use of gas engines as prime movers in electric power stations will increase rapidly in the future at the expense of the steam engine. Much work has been expended during the past few years to increase the efficiency of central station operation, and since the gas engine has a higher thermal efficiency than other prime movers, it will be adopted where suitable conditions prevail. One condition is a low-priced fuel. Gasoline can not be depended upon because it is expensive. Natural gas, while good, is available in but few districts and the continuity of supply is somewhat uncertain. Water gas is expensive and has an undesirable high percentage of hydrogen. For these reasons the only fuel that promises well is the so-called producer gas. The fuel bill of an electric power plant is always a large item, and there are few plants which have large units that can show a fuel consumption as low as two pounds of coal per brake-horse-power-hour. With producer gas, on the other hand, an economy of one pound of coal per brake-horse-power-hour is common practice, even with small units. In gas-producer plants that utilize some of the sensible heat of the gas for preheating the fuel and the air and superheats the steam used in the producer by means of the heat in the engine exhaust, a still higher economy may be obtained. In this respect one of the greatest advantages of producer gas is its ability to give practically the same degree of thermal efficiency in small plants as in large ones. A producer-gas plant in a small village can be operated almost as efficiently as the plant of a large city. Further, the high fuel economy decreases the cost of handling fuel and ashes and reduces the coal storage area necessary. Such a plant also gives greater choice of location, because of the decreased space required for the buildings and the lessening of the water requirements. The water needed for a producer-gas plant is less than one-eighth of that required for an equivalent steam plant. An incidental advantage of the gas plant is the absence of smoke. Another is the removal of the danger of boiler explosions. The elimination of the chimney is also advantageous. By adding a gas holder to the plant a reserve is obtained in case of accident to the producer or for meeting unexpected overloads. There is no loss of energy in such storage. The piping problem is less troublesome in a gas plant than in a steam plant. For large power plants it may be advantageous to utilize the by-products of the producer. In addition to the gas furnished to the engines, the nitrogen in bituminous slack can be converted into ammonium sulphate, a valuable fertilizer. The author believes that the applications of producer gas for power purposes will not be limited to generating stations, but that such equipments will compete with electrically operated cars. Gasoline-engine-driven traction cars are now in practical operation. It would be a small matter to add to such equipments a suction gas producer and replace the gasoline with producer gas. With gasoline at twelve cents a gallon and coal at $5 a ton, a brake-horse-power-hour costs one and one-half cents with gasoline and one-quarter of a cent with coal; hence the cost of power per hour for a 100-horse-power car would be $1.50 for the former and twenty-five cents for the latter. The cost of such car equipments would be more than the cost of the electric motors, but, on the other hand, the gas system would eliminate a central power plant and the entire conductor system.—*Abstracted from Cassier's Magazine (New York), February.*

The Durham, England, Collieries Electric Power Scheme.

A power-house has been erected at Philadelphia, near Penshaw, Durham county, England, to supply power to the large group of collieries and works in the eastern part of that county. The undertaking is a private one and does not possess statutory powers. The plant is close to the mouth of the Lambton pit and thus obtains coal at a low price. The considerations of cheap coal supply had more influence in the choice of a site than facilities for obtaining water, for in order to get the latter it has been necessary to lay a pipe line two miles in length from the power-house to the Weir river. This pipe is ten inches in diameter and delivers water at the power-house, which is 274 feet above the level of the river, by means of a pumping station placed at the lower end of the pipe line, which contains two centrifugal pumps driven at 1,500 revolutions per minute, each capable of delivering 500 gallons of water against the above head. These pumps are driven by a pair of eighty-brake-horse-power, three-phase motors taking current at 230 volts. The motors are started by automatic starters operated from the power-house through an auxiliary three-core cable, so that the pumps are controlled entirely from the main switchboard. This auxiliary cable and main pump motor cable are laid in a trench alongside the pipe line, which trench also contains a telephone cable. The general arrangement of the generating plant is on the unit system, each turbo-generator having its own boilers, condensing plant and switch gear. Any one can be operated independently of any of the others. At the present time there are five Babcock & Wilcox boilers arranged in two and one-half batteries and set with a special kind of serrated and perforated brick to improve the efficiency. They are provided with superheaters delivering steam at 180 pounds per square inch pressure, with 150 degrees Fahrenheit superheat. They are fed by means of automatic stokers. The feed pumps are steam driven. The engine room contains five generating sets of the same size, three of which are driven by Parsons turbines and two by Willans & Robinson's turbines. The latter turbines are bolted to the foundations and rigidly coupled to the condensers, which are mounted on springs and provided with flexible pipes. The Parsons turbines are not bolted down, but are con-

nected to the condensers by flexible joints, the condensers themselves being rigidly bolted to the foundations. The condensing water is passed through large cooling towers and a cooling pond. The alternators, which run at 1,500 revolutions per minute, are rated at 1,000 kilowatts each and deliver three-phase current at 6,600 volts, fifty cycles. The generators are star-connected and the middle points earthed. The exciting sets are driven by independent turbines. Two of these are auxiliary sets, each consisting of a 180-kilowatt, continuous-current generator delivering current at 600 volts and a forty-kilowatt exciter on the same shaft. The larger machine supplies power for operating various small motors. The high-tension switchboard is of the cellular type, all switches being controlled from an operator's desk. The load carried by the station consists principally of the collieries and adjacent works, though power is supplied to a small tramway. About seventeen collieries have already installed motors for driving pumps, coal-cutting machinery and underground haulage. As yet no electric hoisting equipment has been installed. Power is delivered at the collieries from substations, where it is transformed from 6,600 volts to 230 volts for small motors and 2,000 volts for large ones.—*Abstracted from the Electrician (London), January 26.*

The London-Glasgow Underground Telegraph System.

The underground telegraph system connecting London, England, with Glasgow, Scotland, is now nearing completion and a brief description of the work is given here. The actual length of this line is 409.5 miles, which may be shorter than some continental underground telegraph lines, but the total mileage of wire exceeds that of any similar line. Over 37,700 miles of wire have been laid down. The route followed by the cable is from London to Birmingham, then through Stafford, Warrington, Preston, Kendal, Carlisle, Beattock and Glasgow. The pipe line consists of cast-iron pipes, each nine feet long, not including the socket, and having a nominal internal diameter of three inches. Great care was taken in selecting these pipes to see that no pipe was less than three inches in diameter. The average diameter is three and one-eighth inches. The line is divided into sections about 150 yards long between Birmingham and Carlisle, and 220 yards between Carlisle and Glasgow. The pipe is laid on an average not more than fourteen inches below the surface of a footway and not more than two feet below the surface of a roadway. At intervals of five miles the cable conductors are led into connection boxes fitted in pillar test boxes. These boxes provide facilities for making all ordinary electrical tests, also for air-drying the cable in case the insulation becomes defective. The box consists of a cast-iron frame with two cast-iron covers, divided into two compartments by a vertical partition. This partition is pierced by rows of holes fitted with connection pins insulated with ebonite. The conductors from the cables which are to be connected together are soldered to the pin in the air-space side of the partition. This is then closed up by the cover and the sheath of the cable is soldered to gun metal nozzles, making the whole chamber air tight. The conductors are then connected together as may be desired in the other partition of this box. All tests can be made from this side without opening the cable side. The pillar boxes in which these connection boxes are set is about three and one-half feet high and is set on a brick foundation. For joining the different sections of cable together junction boxes of various types are provided where the wires are joined and the cable covered with a lead sheath provided with a brass air nozzle for drying purposes. The cable line from London to Birmingham is 117 miles long and contains seventy-six conductors, each weighing 150 pounds per mile. From Birmingham to Warrington the type of cable used is modified by placing around the other wires a ring of twenty-nine screened conductors immediately next to the lead sheath. These screened conductors consist of wires weighing seventy pounds per mile, insulated with paper and covered externally with copper ribbon, which makes contact with the lead sheath, so that each conductor is surrounded by an earthed screen which completely shields it electrostatically from the inductive action of currents in neighboring conductors. The copper tape also acts partially as an electromagnetic screen, enabling the adjacent conductors in the cable to be worked over long distances without appreciable inductive interference. These screened conductors are intended for local telegraphic communication between the various towns on and near the route of the cable. The cable core inside the ring of screened conductors is made up of seventy-four conductors, each weighing 100 pounds to the mile, paper-insulated, and laid up in twisted pairs in the usual way. Different lays or lengths of twist are given to the groups of pairs in the several layers to prevent the practical parallelism and consequent mutual interference which would otherwise result. In the section north of Warrington the whole cable is of a uniform type, differing somewhat from the type just described. It has the same layer of twenty-nine screened, seventy-pound conductors immediately under the sheath, but the inner core consists of fifty 100-pound and twelve 150-pound conductors. The 100-pound conductors are formed into groups of four pairs each by successive twinning. Two pairs are twisted together to form a group of four conductors, and two such groups of four conductors are twisted to form a group of eight conductors. The complete core is formed by using a group of four conductors made up as described as a centre and surrounding this with six similar groups, and placing one pair of 150-pound conductors in each of the six spaces between these groups and the screened conductors. The advantage of this method is the facility which it affords for joining up conductors in parallel so as to obtain circuits of greater conductivity without increasing the capacity in anything like the same ratio. For telegraphic communication it is possible to work quadruplex on the seventy-pound conductors for 150 miles, and quadruplex plus duplex on any individual pair of 100-pound or 150-pound conductors to a distance of over 200 miles. The two wires of a pair are insulated with paper of the same color, but one wire is marked with a red and the other with a white string. The groups of pairs are wrapped with distinguishing colored papers. At the junction boxes the individual wires are joined by small copper sleeves, and care is taken that the wires of a group of one of the cables are connected with the corresponding wires of a similarly formed group of the other and that these wires are not crossed from one core to another, but the most convenient main cores may be selected for jointing. Warrington is the most important centre of the system, as from here cables to Liverpool, on one side, and to Manchester and Leeds, on the other, branch off. Moreover, this town is midway between London and Glasgow; and hence it is probable that repeaters would be installed at this point for through working should they be found necessary. —*Abstracted from the Electrical Review (London), January 12 and 26.*

Methods of Getting New Business.

A department devoted to the commercial development of Central Stations. Managers are invited to contribute suggestions for methods of increasing the demand for electric service.

The San Antonio Gas and Electric Company, San Antonio, Tex., is one of the most progressive of modern central stations. The commercial department is under the management of Mr. D. M. Warwick. In San Antonio the commercial department has been in vogue for one year ending January 21. During this time it has increased the gross earnings of the company very substantially. The commercial department consists of the commercial manager, four representatives, an application clerk and a stenographer. The commercial department is an individual department in itself, enabling the keeping of all possible records, such as cost of maintaining, new cost, construction cost, advertising expenses and the increase of sales of gas and electricity. In addition to these records, the department compiles the different classes of prospects, such as water heaters, ranges, gas heaters, laundry stoves, soldering furnaces, tailors' stoves, multiple and triple burners, gas engines, etc.—in fact, everything pertaining to the industrial and domestic end of the gas business.

Light Your House With Electricity

supplied by the San Antonio Gas & Electric Co. Its merits are of the utmost stability, and when once installed there is no more expense than that for electricity consumed. Our service is of the highest efficiency, and always like our light, thoroughly reliable. In comparison with other methods of lighting, the cost of our system will be found much more economical.

LET US SEE YOU ABOUT IT
Both Phones 315

San Antonio Gas & Electric Company

Not A Ghost

of a show for dark corners in a house illuminated by electricity.

¶ It is good to read by, to sew by, to play and sing by, to dance by, good for dining room, chamber or hall.

¶ Let us talk to you about it.

315 BOTH PHONES

San Antonio Gas & Electric Company

In the electrical department there are kept separate records of all outlining, window lighting and sign prospects. To each and every sign prospect there are mailed special letters calling attention to the advantage of either gas or electricity over other methods; also to the advertising advantages of electric signs, window lighting and outlining. In addition to these letters the company follows up the different prospects by personal solicitation. Besides personal solicitation the company uses newspaper advertising, street car advertising, billboard and souvenir advertising, which is presented by the representative to the prospective consumer.

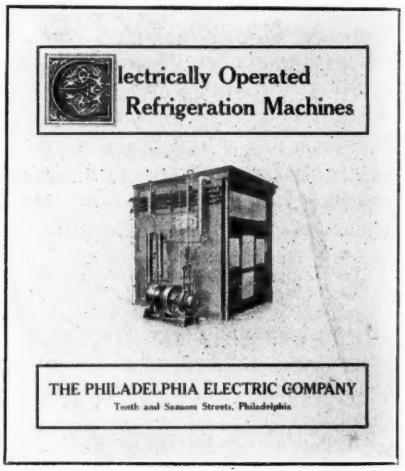
Each representative of the company has a district. The city of San Antonio is divided up into four districts. Each district is carded, giving information as to the different appliances in use in each house in each district. From these cards the department determines the prospects, which are checked up daily. This enables the representatives to plan their work in a systematic manner.

All business secured through this department is estimated on a year's basis. All representatives are paid a fixed salary and a percentage on the gross increase over the same month of the preceding year. The percentage of this gross increase is determined by a point system which the company has in vogue. The company's reason for this is that it increases the incentive of the representatives to secure more business and they work more vigorously along all lines. If the compensation were on a straight salary basis the inducement would not be so satisfactory. The compensation of representatives and the way to secure the best results are questions that have been open for discussion for some time, and the method which the San Antonio company is using has proved very satisfactory.

Each representative acts as a manager of his district. He follows up all complaints and removals, and pays just as much attention to retaining old consumers as he does to securing new ones. The chief object is to increase the revenue without increasing the investment. This is done by working along the present lines. A campaign worked out in this way, the company assures, has been productive of the most excellent results.

A very special form of advertisement which the company has recently made use of is the distribution with bills and other communications of a series of cards. Each of these cards bears some peculiar illustration and a brief statement with reference to the utility or advantage of electricity or gas service. The accompanying illustrations show two of these cards, which are typical of the whole series.

The Philadelphia Electric Company, Philadelphia, Pa., has recently issued a very handsome booklet in black and orange, calling attention to the excellent results obtained from electrically operated refrigeration machines. Not only is the typography excellent in every detail, but the information is particularly interesting.



A Cover Design in Orange and Black.

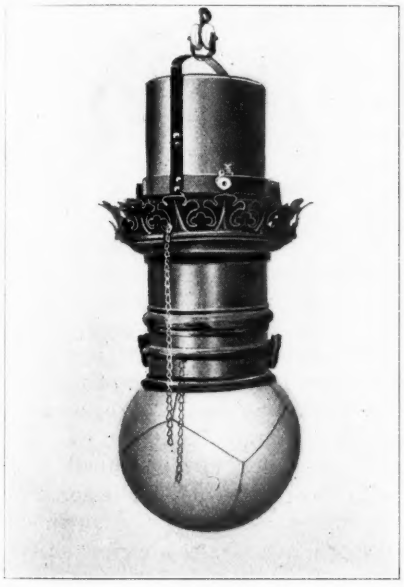
Data are given concerning four particular installations, in each of which there had been made an extensive use of ice refrigeration. The figures for a dairy installation showed a saving over previous ice consumption of $43.50. For a grocery store the difference in favor of an electrically driven outfit was $44.99. For a drug store the difference in favor of the electrically driven machine was $584.46. For a butcher shop the difference in favor of electrical refrigeration was $48.46. Added to this was the absolute reliability and convenience and flexibility of the electric system, together with the elimination of many forms of waste and disorder which obtained with the use of ice.

INDUSTRIAL SECTION.

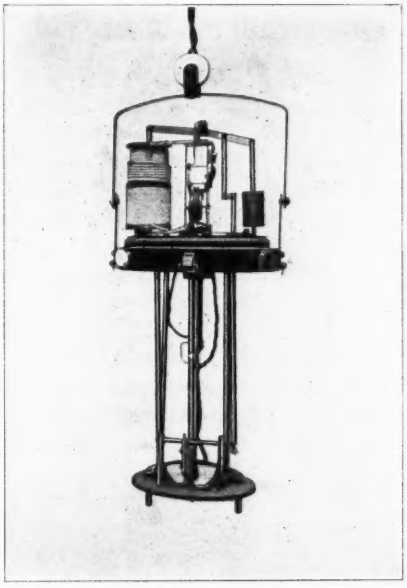
ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

The Siemens Flame Arc Lamps.

At the electrical show held in the Coliseum, Chicago, Ill., from January 15 to 27, a type of lamp which attracted a great deal of attention was the Siemens flame arc lamp, which has been placed on the market by Felix Hamburger, 90 William street, New York city. According to the carbons used the lamps produce a brilliant white light, a red light or a glowing yellow light. The luminous intensity of each of these lamps, connected in series on a 110-volt direct-current circuit, is about 4,000 candle-power, the current used being about eleven amperes. The carbons used are of



SIEMENS FLAMING ARC LAMP.



SIEMENS FLAMING ARC LAMP WITHOUT CASE AND GLOBE.

the impregnated type, which give to the lamp its characteristic feature. The arc is formed at the lower end of the two pencils, which are placed at a slight inclination from the vertical position. The pencils pass through two openings in a disc of refractory material, which serves also as a deflector of the upward rays. This increases the useful light of the lamp. There are no side braces nor retaining mechanism in the path of the rays, and as there is no lower carbon, the light given forth by the lamp is free from shadows. According to the rate of consumption, the pencils are fed downward by an automatic gravity arrangement. With the direct-current lamp the two pencils are lowered at the same longitudinal rate. The positive and negative pencils are made of different sizes, so that the proper consumption of each is proportioned. The actual regulation of the current taken by the lamp is accomplished by separating the points or bringing them nearer together, according to the strength of the current.

The lamp current, when the switch is closed, passes through a series coil on a compound-wound electromagnet, which serves to keep the points of the pencils in the horizontal direction until the current reaches its normal value. The shunt coil of the magnet is connected across the pencils of the lamp, and its magneto-motive force serves to draw the pencils together if the voltage is above normal. A clockwork escapement device operates the pencils, allowing them to descend gradually under the force of gravity when the electromagnet has drawn its core to the end of its travel, corresponding to the minimum separation of the poles. This electromagnetic regulator is provided with the usual dashpot. When the feeding mechanism to which the pencils are attached has reached the end of its travel in a downward direction, a catch, which holds the main-line switch closed, is tripped, and a spring causes the switch to open, so that the arc may be dissipated.

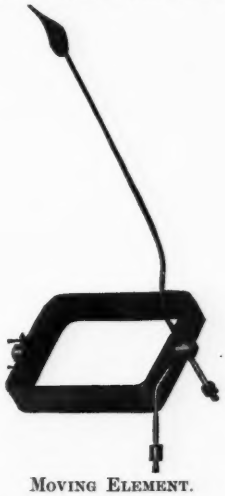
The lamp is insulated with asbestos and fire-resistive tape. The stationary parts are insulated with mica, the cables connecting the moving pencils and the stationary portions being threaded through insulating glass beads. The lamps are usually provided with ten-hour carbons.

International Electric Meter Company's Switchboard Instruments.

The International Electric Meter Company, Chicago, Ill., has developed a line of switchboard instruments on the well-known principle of the Deprez and D'Arsonval gravity system. The salient features of these instruments are the finely divided scale and the positive dead-beat action of the moving parts. These effects are obtained by the use of a very light coil and metal frame mounted on a suitable suspension, which is free to turn in the uniform field of a strong permanent magnet.

ROUND TYPE, SWITCHBOARD PATTERN AMMETER.

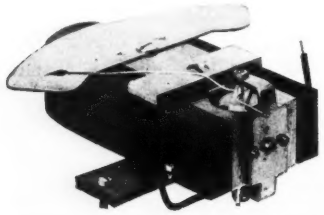
The International meter contains many new details of construction. A prominent feature is the riveting of the jewel stud or pivot directly into the aluminum coil frame, making a rigid and permanent construction. The coil is wound upon the inside of the frame, which gives added protection to the coil. The construction of the needle and its support is said to be mechanically perfect, making it rigid and strong, and of a minimum weight.



MOVING ELEMENT.

The needle is of solid aluminum wire, and, while it is of sufficient stiffness, can be severely deformed without breaking.

In order to ensure the nearest possible approach to perfection in the laying off of the scale graduations, the main divisions

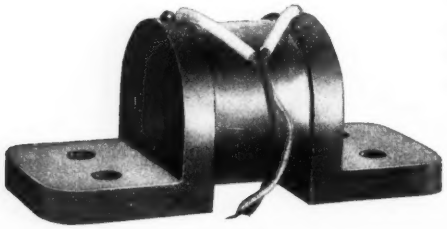


INSTRUMENT WITH CASE REMOVED.

are stepped off with the current and the lines are drawn in by hand.

Tungsten steel of the best grade is used in the magnets and imported sapphire jewels are used in the bearings. All parts, except those actually necessary to carry current, are dead.

The voltmeters are high in resistance and can be used for ground resistance readings. The ammeters are used in connection with a shunt of low temperature coefficient and are operated on 0.04 volt. The shunt is composed of a metal which has a very low temperature coefficient and



EXTERNAL SHUNT.

is of a convenient design for switchboard use. It is arranged to be clamped to the surface of the bus-bar, eliminating the fitting of the bus-bar into slots.

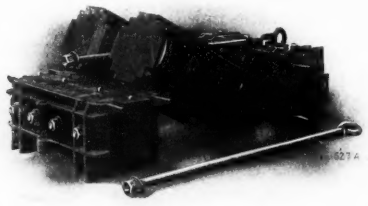
The instruments are of the round pattern, made for both flush and standard mounting, in all standard capacities and finishes. They are made in two sizes—nine and three-eighths inches and seven and three-quarters inches in diameter. The case is composed of cast iron and acts as a shield to the meter in case it is placed in a magnetic field.

The International Electric Meter Company is organized under the laws of the state of Illinois. Mr. W. W. Cheney, Jr., is president and treasurer, and Mr. August Benson, secretary; Mr. John M. Lee, electrical engineer, and Mr. Julian S. Jackson, sales manager.

The Crocker-Wheeler Company's Core Type Transformers.

The Crocker-Wheeler Company, Ampere, N. J., has developed quite recently a line of core type transformers embodying the newest ideas in the design and construction of this form of apparatus.

The accompanying illustrations will present some idea of the construction and assembly of these transformers. Parts of the core are shown. The core consists of four parts: two legs, which support the



DETAILS OF THE CORE OF CORE TYPE TRANSFORMERS.

windings, and two yokes which complete the magnetic circuit. Each of these parts is assembled from laminated steel, the sheets being separately insulated and bolted firmly together by insulated bolts and washers. Bulging of the sheets is prevented by the use of braces and heavier plates where an abrupt change occurs in the section of the core. Ventilating or oil ducts are run in the direction of the oil circulation, keeping the core uniformly cool throughout. Along the four corners of

CONSTRUCTION OF THE CORE OF CORE TYPE TRANSFORMERS.

each leg are cooling ducts. This construction of the magnetic circuit facilitates assembly and dismantling.

At all joints the surfaces in these transformers are milled. The cutter of the milling machine is wide enough to embrace the entire surface to be milled, even in the largest sizes. In cutting, however, the direction of the feed is such that adjacent plates will not come in contact on the milled surface and eddy currents will thus be avoided. Even in case of contact, however, these eddy current losses are restricted to a small area and thickness of metal, so that they may be considered negligible. The milled joints offer another advantage in that they present a very small resistance to the magnetic flux because of the nicety of fit. This is demonstrated by the small magnetizing current of these transformers.

In insulation this core type transformer presents the advantage of great simplicity. The circular cross-section has a double advantage in allowing the use of a circular or cylindrical winding and of cylindrical insulation, eliminating sharp corners and bends and reducing the possibility of cracks or breaks. A resultant economy is found in both material and

INSULATING CYLINDER.

labor, the mean length of winding for a circular cross-section being a minimum. As the cost of copper is about five times the cost of sheet steel, the great importance of a small mean length is evident. Low copper loss and good regulation are the natural consequences. Furthermore, there is no form of coil that is safer, easier and quicker to wind. In the core type transformer a uniform temperature is secured, avoiding stresses between the various parts; and as the entire coil system can be exposed to the freely circulating oil, it is a simple matter to maintain a uniformly low temperature.

CAST-IRON BASE TO WHICH TANK IS BOLTED.

A noticeable feature of these transformers lies in the supplementing of the oil insulation by insulating cylinders, one of which is placed between the high and low-tension coils and one between the coils

and the core. Ample "creeping" surfaces are allowed, doing away with taping on the coils. The ample spacing, with the "creeping" surface and the interposition of the insulating cylinders, render this principle of insulation applicable for transformers built for voltages even as high as 100,000. The taping which is apparent in the illustrations represents a thin layer which is applied for mechanical protection.

HIGH-TENSION COIL.

CORE TYPE, OIL-IMMERSED TRANSFORMER.

The high-tension and low-tension coils, and the high-tension coils and the core are entirely separated from each other by oil ducts and by large creeping surfaces. This is shown in the illustrations.

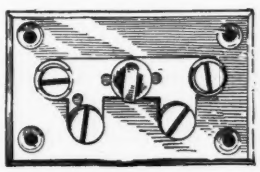
Transformers of this type, of various capacities, have withstood extremely high-voltage insulation tests dry, *i. e.*, before being submerged in oil, without showing a noticeable static discharge. One of the factors making this result possible is the treating of the entire system of high and low-tension coils with a special vacuum process, so that there is no fibrous material which is not moisture-free and impregnated with the insulating compounds. The impregnating material is a linseed oil compound. Under the influence of the internal heat of the transformer the oil oxidizes and cements the turns and layers of the coils firmly, but at the same time flexibly, rendering the entire insulation of a higher dielectric strength.

LOW-TENSION COIL.

In the design of these transformers the Crocker-Wheeler Company has not been restricted by old theories, patterns, dies or obsolete parts. The apparatus represents the latest thought and the result of extensive experience in this department of design and manufacture. The transformers are manufactured in all sizes from one-half to 4,000 kilowatts, for any commercial frequency, and for voltages up to 200,000.

The Thompson Series Connector.

The Charles A. Thompson Company, 39 Cortlandt street, New York city, has for some time been supplying the trade with the Thompson series connector shown in the accompanying illustration. Occasions frequently arise when it becomes necessary to insert ammeters, wattmeters or other measuring devices in the circuit without interrupting the supply of current. In many cases there is an objection to the use of jumpers because of the time consumed in making the necessary connections and because, due to hurried work, these connections frequently prove uncertain, insecure and dangerous, particularly if the circuits involved are carrying heavy currents.



THOMPSON SERIES CONNECTOR.

The Thompson series connector is a simple, compact device. This permits the immediate cutting in on circuits of any current capacity without danger of overheating the connections or interrupting the circuit. Its use also facilitates the removal of series instruments from live circuits for the purpose of calibration or repair without loss of time. The small dimensions of the connector render it well adapted for installation on the back of switchboards, where space is an important consideration. Where the connector is installed on the secondaries of current transformers it eliminates the liability of burn-outs due to open circuits, should the instrument be removed for repairs.

French Carbon in United States Batteries.

The desire of the leading French carbon makers to introduce their carbon in the United States has found consummation in the establishment of the French Battery Company, incorporated recently with headquarters at 69-75 Wells street, Chicago, Ill. The new process, which has been introduced with success into the manufacture of dry batteries, enables the manufacturer to produce an article which meets exacting requirements upon an economical basis, and which prevents rapid deterioration of the product.

The projectors of this enterprise have recognized the fact that the consumption of dry batteries in the Mississippi valley, and, in fact, the entire western field, is one which renders possible a very extensive trade for a western manufacturer, eliminating expense and delay in transportation. The company has selected Chicago as being a natural commercial centre. Chicago also offers the company advantages by reason of its shipping facilities and accommodations, not only in regard to the procuring of raw material and manufacturing the finished article in rapid style, but also as regards the prompt shipment of orders to all parts of the country.

Mr. Alfred Landau, who has supervision of the new establishment, has, it is announced, gained an extensive knowledge of all the essential details entering into the battery business by years of study and practice in Europe. He has also spent considerable time in various parts of the United States, familiarizing himself with the conditions of trade in this country before opening the factory. The factory, he announces, will be conducted independently of any combination and the batteries will be manufactured of the best French material by the new French process.

The French Battery Company announces that its batteries have a high amperage and long life, with exceptional recuperative powers. The company also handles globular carbons of all sizes and, in addition, will manufacture flashlight batteries of every description.

Electrically Driven House Pumps.

The Prindle Pump and Engineering Company, 95 Liberty street, New York city, has for some time been furnishing an automatic outfit for house-tank pumping. Where water is needed for domestic uses property owners and tenants demand a pump that will be noiseless, odorless, automatic, simple and economical, requiring no skilled labor and being subject to but slight repairs. These pumps are required for lifting various kinds of liquids to any height. Horizontal and vertical types are necessary and the work covers some of the sewage and cellar drainage operations.

Fig. 1 shows a Prindle standard house-tank pump and direct-current motor.

The pump may be set on a small foundation about eighteen inches high, or on cast-iron legs. This height will raise it above the dampness of the floor or from dirt raised by sweeping, and also make it easy of access. The use of a centrifugal pump gives a continuous movement of the water, eliminating pulsation or vibration in the pipe lines. The automatic float arrangement maintains the water in the tank at a proper level, avoiding losses through overflow and saving attention. Where an alternating-current supply is available, particularly for outlying and suburban districts, the company furnishes an alternating-current motor direct-connected to the centrifugal pumping outfit.

The opportunity for increasing considerably the demand for current has caused many central station managers to establish favorable rates for the installation of house-tank outfits. The evolution of manufacture of the last decade has brought the design and construction of pumping plants to such a degree of perfection that the electrically driven house-pump is to-day one of the most satisfactory of modern conveniences.

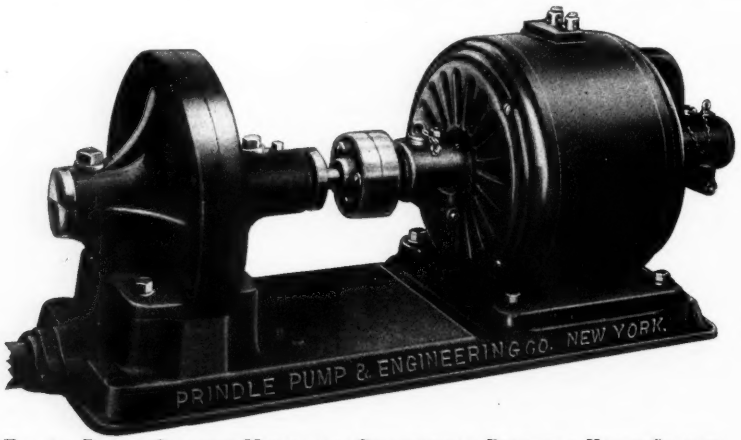


Fig. 1.—Direct-Current Motor and Centrifugal Pump for House Service.

Foreign Business of the General Electric Company.

A group of recent orders taken by the General Electric Company, Schenectady, N. Y., through its foreign department at Schenectady and New York is interesting as typical of the extensive foreign business of this company and as illustrating the part taken by the electrical interests of the United States in the foreign markets of the world. The variety of uses for which this electrical apparatus is intended is also significant.

From Australia, through the Australian General Electric Company, an order for Wellington, New Zealand, calls for a Curtis steam-turbine generator of 500 kilowatts capacity for use in furnishing electric light and power.

Japan furnishes orders through Bagnall & Hilles for the electrical equipment of a large coal mine, including a generator of 180 kilowatts output, to furnish power for a number of induction motors aggregating 200 horse-power. In addition other Japanese orders for induction motors amount to 575 horse-power in sizes from twenty to fifty horse-power.

South American orders include electric railway apparatus for Bahia tramways, Bahia, Brazil, through Guinle & Company, Rio de Janiero, consisting of three motor-generator sets of 300 horse-power each and three sets of 225 horse-power each with necessary switchboard and electric car equipments for thirty-six cars of a total capacity of eighty horse-power each. For a lighting plant at Lincoln, Argentine Republic, is included a gas-engine-driven 130-kilowatt generator, ordered through the South American General Electric Supply Company, Buenos Ayres. For Lima, Peru, one order includes sixteen two-motor equipment of eighty horse-power each for electric cars.

For use in Africa the South African General Electric Company, Johannesburg, has ordered nearly one hundred induction motors of an aggregate capacity of 2,175 horse-power.

One order from India consists of four water-wheel driven 1,000-kilowatt electric generators and two of 150 kilowatts each, six 60,000-volt transformers, each of 1,000-kilowatt capacity, in addition to line material such as wires, insulators, lightning arresters, etc., for a sixty-five-mile transmission system, and a complete output for 2,000 kilowatts of substation equipment. This is for the Jhelum river power installation at Kashmir, India.

For the Prussian government railways of Germany there are being constructed six Sprague-General Electric Type-M control equipments, each for two 125-horse-power motors, and thirty Tirrel voltage regulators.

The Metropolitan railways, London, England, has ordered, through the British Thomson-Houston Company, electric car equipments for twenty cars, each consisting of four 200-horse-power motors and Sprague-General Electric Type-M control system and for forty trailer cars.

The French Thomson-Houston Company has ordered three 1,000-kilowatt Curtis steam-turbine generators for installation at Marseilles, France.

The foreign markets nearer home have been equally active, as is shown by the following orders, which are typical of this part of the General Electric Company's foreign business.

The Canadian General Electric Company has ordered a 500-kilowatt Curtis steam-turbine generator for the Winnipeg Electric Railway in Manitoba.

From Mexico, through the Mexican General Electric Company, orders have been received for apparatus consisting of two 300-kilowatt generators complete with exciters and generating station equipment for the Cananea Consolidated Copper Company, Sonora, Mexico; for the Minas Tecololes y Aneas, Chihuahua, Mexico, a lot of induction motors totaling 1,000 horse-power and two mining locomotives; for Negociacion Minera de Guadeloupe, Mazatlan, Mexico, two 200-kilowatt generators with exciters and switchboard and nineteen induction motors aggregating 400 horse-power; for Mexico electric tramways, Mexico City, four two-motor forty-horse-power railway equipments.

The Inter-Mountain Power Company proposes to construct in the spring three hydroelectric power stations about seventeen miles from Salt Lake City, Utah, at a probable cost of $500,000. Frank C. Kelsey, Salt Lake, is engineer.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

BUFFALO SUBWAY—The Buffalo Subway Railway Company has been incorporated with a capital of $1,000,000 to build a subway in Buffalo, N. Y., similar to the one in New York city. It is understood that Philadelphia capital will furnish the money.

A NEW HOLDING COMPANY TO FINANCE TRACTION, GAS AND ELECTRIC INTERESTS—The Traction, Gas and Electric Finance Company, of New York city, has been incorporated at Albany, N. Y. The company is formed as a holding company and the capital stock is $500,000. The directors are John E. Borne, Cord Meyer, Stephen Peabody, Joseph H. Mayer and William F. Sheehan.

BALTIMORE CITY COUNCIL LETS INTERURBAN RAILWAY ENTER THE CITY—The committee on highways for the city of Baltimore, Md., has reported favorably to the Second Branch the ordinances granting to the Baltimore Terminal Company, which represents the Washington, Baltimore & Annapolis Electric Railway and to the United Railways and Electric Company, franchises on German street. Considerable opposition to the granting of these ordinances was developed, as it was considered possible in many quarters to have the city build a municipal interurban terminal.

MUNICIPAL LIGHTING PLANT FOR LOS ANGELES, CAL.—A provisional order has been placed before the city council of Los Angeles, Cal., providing for the establishment of a municipal lighting plant costing $1,000,000. The order provides that the money shall be raised by a bond issue, and asks that the city attorney be instructed to draw up an ordinance and have this submitted to the people at the next municipal bond election. The order was referred to the legislative committee, which was instructed to consult with the city attorney as to the preparation of the required ordinance.

MICHIGAN POWER COMPANY REORGANIZED—One of the largest deals in the history of Lansing, Mich., was consummated on Friday, February 2, in the reorganization of the Piatt Power and Heating Company as the Michigan Power Company with a capitalization of $2,500,000. The new company acquires the heat and power franchises and the plant in Lansing, also power rights and dams along the Grand river from Dimondale to Portland, developing 15,000 horse-power. Announcement is made that $1,250,000 will be expended in the next two years in building additional dams and a central plant.

TELLURIDE POWER COMPANY TO CONSTRUCT NEW PLANT—The Telluride Power Company is buying a right of way for its canal from Bear river to Bear lake, near Montpelier, Idaho. The intention of the company is to run the flood waters of Bear river into Bear lake, storing them there for summer use in irrigating land in southern Idaho and northern Utah. The same proposition has been under consideration by the national government. The project means the expenditure of from $1,500,000 to $2,000,000. It is understood that the power company will work in earnest on the project in the early spring.

NORTHERN ELECTRIC RAILROAD COMPANY FILES LARGE TRUST DEED—The Northern Electric Railroad Company, of Oroville, Cal., has filed a deed of trust for $6,000,000 to the Mercantile Trust Company, of San Francisco. The company desires to raise funds to discharge its indebtedness and to carry on its corporate purposes, and found it necessary to issue bonds, securing such bonds by a deed of trust. In order to secure these bonds the company sells, bargains and transfers to the Mercantile Trust Company all its franchises, depots, rolling stock and roadbed between Chico and Oroville, and all other property it has or may acquire.

AN ELECTRIC TRUNK LINE IN VERMONT—Papers completing the merger of the Rutland Street Railway Company, the Chittenden Power Company, the People's Gas Light Company and the Vermont Internal Improvement Company have been filed in the office of the secretary of state at Montpelier, Vt. The last-named concern was chartered by the legislature of 1900 with a capital stock of $100,000 for the purpose of acquiring electric lighting and heating plants anywhere in Vermont. The consolidated concern has a capital stock of $2,400,000 and plans to establish a direct trunk line of electric roads through Rutland county and southern Vermont.

MOHAWK VALLEY COMPANY TO EXTEND ITS OPERATIONS—The capital stock of the Mohawk Valley Company, which has taken over the control of the Rochester Railway and Light Company and the Rochester Railway Company and the subsidiary companies of the latter, is to be doubled. The company will have a through trolley line that will extend from Albany to Buffalo, N. Y., although the trolley lines of these cities are not included in the merger. It is the intention of the company to make extra extensions north and south from the Albany-Buffalo line wherever it is deemed profitable. An extension that has been considered is from Syracuse to Oswego.

EXTENSIVE CALIFORNIA POWER DEAL—The $50,000,000 company organized by Frank H. Ray, Edwin Hawley and Alfred C. Bedford has taken over the various power, lighting and water companies in Reno, Cal., the paper mill and electric plant at Floriston and the electric plants at Marmol and Laughtons, all located on the Truckee river, together with a large number of power sites on the Feather river in Plumas county, Cal. It is also announced that this company will take over the Big Bend Tunnel and Mining Company's property and that of the Eureka Power Company, located in Butte county, Cal. Brown, Wilson & Company, of San Francisco and New York, financed the proposition.

GREAT EASTERN TELEPHONE COMPANY MAKES APPLICATION TO LAY TELEPHONE WIRES—The Great Eastern Telephone Company, which claims the right to operate a telephone system in New York city under a franchise granted to the New York Electric Lines Company in 1883 by the board of aldermen, applied last week to Commissioner Ellison, of the department of water supply, gas and electricity, for permission to lay wires beneath the streets. Attorney-General Mayer recently recognized the validity of this franchise, the company claims. Ex-Comptroller Grout has been retained by the New York Telephone Company to resist the entry of the Great Eastern Telephone Company into New York city. Mr. Grout contended at the hearing on February 7 that the Great Eastern company's franchise was not valid and that all that Attorney-General Mayer had done was to refuse to take proceedings for the revocation of the charter on the ground that the city had ample means to protect itself against an illegal invasion. Commissioner Ellison gave Mr. Grout a week to submit a brief and intimated that no action would be taken without the advice of the corporation counsel.

LONG-DISTANCE TELEPHONE LINE TO BE ESTABLISHED IN WASHINGTON—A telephone company has been incorporated at Tacoma, Wash., with a capital stock of $5,000,000, for the purpose of building long-distance lines in the Pacific northwest, in competition with the Pacific States Telephone Company. The incorporators include William Mead, L. J. Beyman, of Los Angeles; Roscoe Howard, of San Diego, Cal.; Charles E. Sumner, of Portland, and Edward E. Webster, manager of the Independent Telephone Company, of Seattle. The Independent Telephone Company, of Seattle, has secured a franchise in Tacoma, and this will be transferred to the new company. The franchise provides that work must be begun within three months, and that within six months $50,000 must have been expended. The company will install its service at Everett and Bellingham. It is announced that within sixty days work will be commenced on the new long-distance line between Tacoma and Seattle. The project is to be undertaken by the Northwestern Long-Distance Telephone and Telegraph Company, of California. The line is to be in operation within ten months. It is also expected that long-distance lines will be completed to Portland, Vancouver, Victoria and other cities.

NEW INCORPORATIONS.

DES MOINES, IOWA—Citizens' Gas and Electric Company. $800,000.

LINCOLN, NEB.—Tilden Telephone Company. Increased from $3,000 to $6,000.

LINCOLN, NEB.—Farmer Creek Telephone Company, of Inavale, Webster county. $3,500.

DES MOINES, IOWA—Des Moines, Winterset & Creston Electric Company, Des Moines. $100,000.

SALT LAKE CITY, UTAH—Utah County Light and Power Company. Increased from $50,000 to $200,000.

HARRISBURG, PA.—South Lebanon Electric Company, Lebanon; $5,000. Meyerstown Electric Company, Lebanon; $5,000.

PIERRE, S. D.—Menno Rural Telephone Company, of Menno. $25,000. Incorporators: G. W. Munsmer, M. H. Claggett and Peter Gundmunson.

ROCHESTER, N. Y.—Laube Electrical Company. $15,000. Directors: E. M. Buehl, Charles A. Laubengeiger, Cleveland Babcock, all of Buffalo.

SPRINGFIELD, ILL.—Forreston Mutual Telephone Company, Forreston. $3,000. Incorporators: Henry Zumdahl, H. Meiners and H. Ratmeyer.

COLUMBUS, OHIO—Farmers' Telephone Company. $2,500. Incorporators: M. Dalton, R. M. Patterson, J. C. Harner, H. D. Hooper and Julian Gift.

OREGON CITY, ORE.—Estacada Light and Power Company. $3,000. Incorporators: George F. Martin, William L. Brewster and William T. Muir.

NASHVILLE, TENN.—Memphis Electric Company. $5,000. Incorporators: W. S. Counsell, R. A. Street, Fred Clayton, F. O. Isde and H. H. Bonner.

ALBANY, N. Y.—Northern Electric Railway Company, of Millbrook. $600,000. Directors: E. H. Rippee, Jr., C. C. Ferber, Scranton, Pa.; F. L. Fuller, New York city.

AUSTIN, TEX.—Reeves County Telephone Company, of Pecos city. $20,000. Incorporators: C. W. Kelley, R. S. Johnson, R. G. Sage, F. W. Johnson, W. D. Cowan and G. B. Laudman.

DETROIT, MICH.—Benton Harbor-St. Joseph Railway and Light Company. A consolidation of the St. Joe River Traction Company and the Southern Michigan Light and Power Company. $1,000,000.

GUTHRIE, OKLA.—Lyle & Clyde Local Telephone Company, of Clyde. $1,000. Incorporators: E. P. Peters, S. C. Fink, W. A. Devore, F. P. Privett, James Salmon, John Clark and Perry Robbins.

PORTLAND, ORE.—United Railways Company. To build a road from Portland to Peak, in Washington county. $5,000. Incorporators: W. D. Larrabee, M. H. French, J. Whyte Evans, all of Los Angeles.

SPRINGFIELD, ILL.—Ottawa & Streator Power, Light and Traction Company. To construct an electric railroad from Ottawa to Streator. $50,000. Incorporators: Matthew Thorne, William E. McLean and M. W. Kelly.

ALBANY, N. Y.—The Fisher's Island Railroad Company. To operate a cable or electric line on Fisher's Island, Suffolk county. $12,000. Directors: Walton Ferguson, A. L. Ferguson, New York; Frank E. Hein, Fisher's Island.

PIERRE, S. D.—Citizens' Economic Telephone Company, of Fedora. $2,500. Union Telephone Company, of Henry, $10,000. Incorporators: John T. Belk, Henry A. Hanson, Henry Hanson, Nels M. Hanson and Ernest Reinecke.

MINNEAPOLIS, MINN.—Duluth Edison Electric Company, Duluth. $2,000,000. Incorporators: Arthur B. Chapin, Robert P. Dowse, Jay W. Lyder, Jr., Joseph E. Horak, Charles J. Grogan, Charles R. Haines, Duluth; Guy Chase, St. Paul.

PIERRE, S. D.—Langford Telephone Company, Langford. To do a general telephone business in the counties of Marshall, Day, Roberts and Brown. $22,500. Incorporators: C. A. Platt, J. F. D. Cook, Howard Platt, C. B. Hersey, W. H. Sherrard.

ELECTRIC RAILWAYS.

VINELAND, N. J.—A trolley road, by way of Norma, Rosenhayn and Carmel to Bridgeton, is projected.

WARREN, OHIO—Work will be resumed on the Cleveland & Sharon Traction Company's line between Middlefield and Sharon the coming season.

BINGHAMTON, N. Y.—The Binghamton Railway Company has bought eight miles of rails for the construction of an extension from Union to Owego.

FORT WAYNE, IND.—The county commissioners have granted to the Fort Wayne & Winona Interurban Company a franchise through Arcola, completing the right of way between Fort Wayne and Winona.

MANITOWOC, WIS.—A trust deed of $150,000 has been filed by the Manitowoc & Northern Traction Company in favor of the Wisconsin Trust Company. The bonds are $500 each and draw five per cent. The issue is created to pay off an indebtedness, stated to be $118,000, and to give funds for extension of the company's lines.

RICHMOND, KY.—There is a movement on foot to build an electric line to Berea and the foot of Big Hill. The plan is being backed by local and foreign capitalists. The line when complete will be twenty-one miles long and will pass through the most densely populated portion of the county. The proposed route is out of the Big Hill pike to Kingston.

PARSONS, KAN.—The council of Parsons has passed an ordinance granting a franchise to R. C. Rawlins for an electric street railway, to be in operation over seven miles of track within eighteen months. This is a part of a system of interurban railway which is planned to cover southeastern Kansas and southwestern Missouri with 214 miles of track and connect with all the principal towns in the territory.

NEW HAVEN, CT.—The Connecticut Railway and Lighting Company, the builder of the recently completed Cheshire trolley line leading from New Haven north toward Hartford, finds that this route pays so well that it will double-track it from end to end. It is also promised that a trolley service will be opened between Meriden and Waterbury, passing through Cheshire, within a comparatively short space of time.

SAN JOSE, CAL.—At an adjourned meeting of the common council a franchise was granted to the San Jose & Santa Clara Railroad Company for a broad-gauge electric railroad on Santa Clara street and Tenth street for a period of fifty years. The railroad company at present has a franchise over the right of way mentioned, but it has only eighteen years to run. Under the new fifty-year franchise extensive improvements will be made. The road will be newly equipped, and cars will be run on a five-minute schedule.

TOLEDO, OHIO—East Side men and New York parties are reported to be back of the new Toledo & Columbus Electric Railroad Company. Directors were chosen as follows: H. R. Klauser, William Finlay, Sr., D. T. Davies, Jr., William Finlay, Jr., Mark Winchester and D. H. James. D. H. James was elected president, William Finlay, Sr., vice-president; H. R. Klauser, treasurer, and Mark Winchester, secretary. The object is to build a connecting link between Toledo and Columbus and put on a through service. The exact route has not been fully determined and part of the distance two routes are under consideration.

PANA, ILL.—At a meeting of the directors of the proposed interurban line between Mattoon and Hillsboro, running through Pana, the organization perfected its arrangements and plans for work, to commence early in the spring. The name of the new road will be the Mattoon, Shelbyville, Pana & Hillsboro Traction Company, and it will be incorporated with a capital stock of $10,000. The directors elected are as follows: Arthur Kincaid, Irving; A. M. Howell, Hillsboro; W. R. Patton, Charleston; I. W. Craig, Mattoon; A. W. Treat, Gays; A. T. Callinson, Windsor; John W. Yantis, Shelbyville; Ed Foster, Terre Haute; J. W. Kitchell, Pana; Robert Johns, Pana; W. O. Wilcox, Rosamond; W. N. Grimes, Ohlman; W. A. Young, Witt. It was decided that the Charleston should be the headquarters of the company. The line will be completed within the next year.

ELECTRIC LIGHTING.

TECUMSEH, NEB.—The village of Sterling will have an electric light plant.

ADAMS, NEB.—The new electric light plant has been completed at a cost of $8,000.

BOLIVAR, TENN.—An electric light plant has been placed in operation at Bolivar.

WATERFORD, PA.—Waterford has contracted for electric light for a period of five years.

CLOVERSPORT, KY.—It is purposed to establish an electric light plant at Cloversport.

GIDDINGS, TEX.—Bremond parties are arranging to install an electric light plant at Giddings.

TROY, N. Y.—The contract for lighting the village of Shushan has been let to L. C. Piser for a term of five years.

LARAMIE, WYO.—Harry McCutcheon has been granted a franchise for an electric light and power plant at Eaton, Col.

CINCINNATI, OHIO—The Cincinnati Gas and Electric Company has decided to increase its capital stock from $5,000,000 to $36,000,000.

GLENS FALLS, N. Y.—The Salem Electric Light and Power Company's property has been sold at foreclosure proceedings to J. H. Stone for $4,300.

LAWRENCEBURG, KY.—At a meeting of the stockholders of the Lawrenceburg Electric Light Company it was decided to raise the capital stock from $10,000 to $17,500.

DANVERS, MASS.—The additions and extensions to the municipal electric plant, for which the town appropriated $20,000 at the last annual meeting, have been completed.

WINFIELD, TENN.—The town of Winfield has granted a franchise to the Winfield Electric Light and Power Company, Limited, to erect and operate an electric light and power plant.

ALBANY, N. Y.—The state gas and electric commission has granted permission to the Ticonderoga Electric Light and Power Company to issue bonds to the extent of $35,000. The company applied for authority to issue $50,000.

DANVILLE, KY.—W. R. Meyers and associates have been granted a twenty-year franchise for an electric lighting plant in Monticello, Wayne county, upon the condition that the work of installing the plant be begun at once and completed within six months.

UTICA, N. Y.—The Hudson River Electric Power Company hopes to have its transmission line to Utica completed by September. The company will furnish power for the Utica & Mohawk Valley Railway from the steam plant until such time as the power can be transmitted to Utica from Spier's falls.

ST. AUGUSTINE, FLA.—The St. Johns Light and Power Company has been awarded a contract for street lighting, covering the period from February 15 to October 15. The contract price is $7.50 a light per month of twenty-two nights for 2,000 candle-power arcs, and $4 per month for 200-candle-power incandescents.

BUFFALO, N. Y.—There has been filed with the county clerk the deed and mortgage given last November by the Niagara, Lockport & Ontario Power Company to the Standard Trust Company, of New York. The document is for $5,000,000 and is given to secure the issue of bonds which is being floated by the company.

TOPEKA, KAN.—Plans and estimates for betterments and extensions to the city electric light plant will probably be asked for by the city council from the city engineer and the superintendent of the electric light plant. The contemplated betterments and extensions will involve an outlay of approximately $25,000.

YORK, PA.—At the annual meeting of the Delta Electric Power Company the new owners elected officers and directors as follows: president, H. E. Ahrens, Reading; vice-president, W. J. Yeager, Lewistown; secretary, Edward D. Ruth, Lancaster; treasurer, James S. Ahrens, Reading. R. B. Kinsey, of Reading, was also elected a director.

UTICA, N. Y.—At the annual meeting of the Richfield Springs Electric Light and Power Company the stockholders elected the following officers: M. A. McKee, president; Madison Vedder, vice-president; Allen J. Bloomfield, treasurer; John Gyer, secretary; N. D. Jewell, J. D. Ibbotson, M. A. McKee, A. J. Bloomfield, M. Vedder, directors.

SCRANTON, PA.—At a meeting of the stockholders of the Household Electric Light, Heat and Power Company the following board of directors was elected for the ensuing year: C. A. Battenburg, F. A. Hendricks, Frank Hemelright, Patrick Bloomer, Patrick Walker, J. B. Griffiths, F. L. Depew, Samuel Waters, Nicholas Bennet, John Marion, C. F. Baker and George Edmunds.

TROY, N. Y.—The Hudson River Electric Light and Power Company has purchased property between the cities of Johnstown and Gloversville, on which it will install a substation for the purpose of supplying light and power in those cities. The franchise of James H. Cross, of Johnstown, passed to the company as a part of the transaction and gives it the desired privileges in that city.

MORRICE, MICH.—Parties from Saginaw have formed the Perry-Morrice Electric Company, and will light Morrice, Perry and Bancroft. The company has secured franchises from the three towns and will build a power plant at Shiawassee town, with distributing stations in each village. The plant will cost about $9,000, and will be in working order in sixty days. There will be at first eleven arc lights in each village, costing $50 each.

JOHNSTOWN, PA.—Samuel Lenhart, Harry Doerr and Dr. C. E. Hannan, of Johnstown, and James T. Shank and John Powers, of Dunlo, have purchased the stock of the Dunlo Electric Light Company, with the intention of making a number of improvements. At present service is given to Dunlo, Beaverdale and Lloydell. The new owners propose to extend the system field to Llanfair and Salix. The present capitalization of the company is $10,000.

LARAMIE, WYO.—The stockholders of the Laramie Electric, Gas, Light and Fuel Company, which recently sold its plant to the Laramie Light and Power Company, have reelected Robert Homer, Eli Crumrine, John H. Symons, C. D. Spaulding, E. C. Jones, E. D. Hiskey and J. T. Holliday as trustees and declared a dividend of three per cent. The company will go into liquidation shortly, having disposed of all its vested rights in the city.

SENECA FALLS, N. Y.—It is stated that the Interurban Gas Company, which supplies gas to Geneva, Waterloo, Seneca Falls and Auburn, has purchased the Seneca Edison company, the corporation which furnishes light to the villages of Seneca Falls and Waterloo. The Interurban company's purpose is to erect a modern electric light plant near the works of the Empire Coke Company at Geneva, which will supply Geneva, Waterloo and Seneca Falls.

CHESTER, PA.—The Lansdowne Electric Company, composed of Lansdowne men, has sold out to a new company composed of J. Lord Rigby, of Media, president; H. J. Makiver, of Media, vice-president; Edward E. Mandeville, of Philadelphia, secretary and treasurer; J. Herbert Ogden and Frank T. Davis, of Lansdowne, directors. There were 644 shares of stock, and the price paid per share by the new concern was $46.50, while the bonds were sold at par, $500.

DENVER, COL.—The American Light and Traction Company, controlled by Emerson McMillan, who is at the head of the Denver Gas and Electric Company, has taken over the Lacombe Electric Company, and it will hereafter be managed jointly with the Denver Gas and Electric Company. Several years ago the McMillan people secured a controlling interest in the Lacombe company, and it has been looked upon as a part of the Denver Gas and Electric Company's plant. It has, however, been conducted under separate management.

SOUTH BEND, IND.—The engineers of the South Bend Electric Power Company, which controls the interests of the Hen Island dam, have completed a survey for a proposed dam in the St. Joseph river on the line between Michigan and Indiana. Plans for the dam and for a power-house are now being prepared. The dam will cost in the neighborhood of $500,000, and will add about 2,500 horse-power to the extensive system of the corporation. The advisability of building on the state line or at Berrien Springs will be considered at an early meeting of the board of directors. The project will cost in the neighborhood of $500,000 and will furnish about 10,000 horse-power. Both dams will eventually be built. Work on one of them will begin soon after the directors come to a decision.

TELEPHONE AND TELEGRAPH.

WINLOCK, WASH.—C. E. Burber will install a telephone system.

OTTAWA, KAN.—The Missouri & Kansas Telephone Company now owns the plant and good will of the Williamsburg Telephone Company.

FRANKLINVILLE, N. Y.—The Home Telephone Company, of Ellicottville, is contemplating a line to Franklinville, thence to Machias and Arcade.

TAYLORVILLE, ILL.—The Interstate Telephone Company, of Taylorville, has purchased the Christian county telephone company's plant located at Pana.

ALBANY, N. Y.—The Independent Telephone Securities Company has filed a notice with the secretary of state stating that it has decided to change its principal place of business from Utica to Rochester.

PULASKI, TENN.—The Cumberland Telephone Company has installed a new switchboard at Pulaski which will accommodate 1,000 subscribers. The company is also installing exchanges at Prospect, Elkton and Campbellsville.

CORTLAND, N. Y.—The Inter-Ocean Telephone Company has completed a line between Ithaca and Cortland. Contracts have been closed with the Dryden Telephone Company, the Marathon Telephone Company and the Miller company.

WASHINGTON, D. C.—The secretary of the interior has awarded the contract for a telephone system in connection with the Huntley irrigation project in Montana. The contract includes twenty-two miles of poles, lines and circuit, and two stations.

DILLSBORO, IND.—The stockholders of the Dillsboro Telephone Company have elected directors with Dr. F. H. Sale president, George F. Heffelmeyer vice-president, Fred Lubbe secretary and G. H. Elderbrook treasurer. A modern plant will be established.

CLARKSVILLE, N. Y.—The Clarksville Telephone Company has elected as directors: A. H. Crounse, C. L. Shear, M. F. Barber, Albert Vanderpool, John S. Loucks; and as officers: president, J. M. Wright; vice-president, D. W. Bennett; secretary-treasurer, A. H. Crounse; manager, Charles L. Shear.

PHILADELPHIA, PA.—The Bell Telephone Company has contracted for the erection of a central office building, to cost about $25,000, near the Philadelphia & Reading railway station, in Jenkintown. The building is designed to handle 6,000 telephones, and at least twenty-five operators will be employed.

DENTON, MD.—At a meeting of the Farmers' & Merchants' Telephone Company the capital stock was increased to $25,000. The line now connects the county seat with the towns of Queen Anne, Hillsboro and Ridgely, and its telephones are already established in many of the farmers' homes between these points and throughout Tuekaho Neck.

OTTAWA, QUEBEC—The Bell Telephone Company, of Canada, is applying to parliament for the right to increase its capital over and above the present authorized amount of $10,000,000. At present the company has issued $9,000,000 of common stock, although that will not be fully paid until next July. The last issue was $1,000,000, made on May 31 last.

ALLENTOWN, PA.—The telephone lines in the lower section of Lehigh county and districts south of it are being extended by the farmers and business men as follows: from Hosensack to Limeport and Vera Cruz, from Hillegass to Fruitville, and from Hoppenville to Finland. These extensions will be operated by the Bell company from its exchange in Pennsburg.

CINCINNATUS, N. Y.—The stockholders of the Otselic Valley Telephone Company have elected the following directors: P. C. Wheeler, F. M. Davis, E. W. Terrill, William Edwards, A. Fowlson, J. H. Murray and J. M. Lotridge. By-laws were adopted, and it was voted to incorporate with a capitalization of $10,000. One hundred and forty-three telephones are in use on the company's lines.

SERGENT, KY.—The Beaver-Hindman Telephone Company is extending its line from Hindman to Colson, where connections will be made with the Whitesburg Telephone Company's line, giving connection with Whitesburg, Harlan, Hindman, Hazard, Prestonsburg and every important town in eastern Kentucky. The Whitesburg Telephone Company's lines are being extended to all parts of the county.

SYRACUSE, N. Y.—The Independent Telephone Company is planning to move to new quarters March 1. This has been made necessary by the increase in business. Lines are being built east and west, and north and south, with a view of linking the two systems that centre around Rochester and Syracuse. From the centre at Rochester extensions are being run into Orleans county. A line north is now laid from Jamestown, and others in Cattaraugus county.

HOMER, N. Y.—At a special meeting of the Homer village board of trustees it was decided to accept the offer recently made by the Cortland Home Telephone Company and papers were signed. The company agrees to install a modern fire-alarm system, free of all cost to the village, to install six free telephones for use in public buildings and by public officers, and to sign contracts with any person to furnish telephone service at the rates now prevailing, namely, $12 per year for residences and $24 per year for business places.

CALDWELL, OHIO—A deal has been closed by which the largest of the telephone companies operating in Noble county have consolidated under the name of the Noble County Telephone Company. The companies in the combine are the Caldwell Independent Telephone Company and the Farmers' Telephone Company, of Caldwell; the Summerfield Telephone Company, of Summerfield, and the Caldwell & Marietta Telephone Company, of Washington county. The system will be managed by the United States Telephone Company. The company will have 200 miles of toll lines.

ENGINEERING SOCIETY.

CINCINNATI CHAPTER, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—The Cincinnati chapter of the American Institute of Electrical Engineers held its first monthly meeting at the Grand Hotel, Cincinnati, Ohio, Wednesday, February 7. Professor C. W. Marx gave a talk on "Engineering Practice in Modern Hotels." The proposition was presented to the local chapter to affiliate with the local chapters of the American Society of Architects, American Society of Mechanical Engineers and the Engineers' Club. The local chapter voted that it was the sense of this body to favor the affiliation. The articles of agreement provide that each organization shall retain its individuality, and that all members of the affiliated bodies shall be invited to the meetings of each organization at which professional subjects are under discussion. It is intended to secure a suitable building at which all meetings can be held, and which shall be accessible to the members for informal meetings. It is further intended to create a library which shall be available to all members. Officers of the local chapter were elected as follows: president, C. S. Reno, chief engineer, Triumph Electric Company; vice-president, A. G. Wessling, engineer, Bullock Electric Manufacturing Company; secretary and treasurer, Laurent Lowenberg, electrical engineer, Reliance Engineering Company.

EDUCATIONAL.

JOHNS HOPKINS UNIVERSITY—The report of the president of the Johns Hopkins University, Baltimore, Md., has just been issued. This gives in detail the work of the university in all its branches, and describes at some length the proposed plans for the new university buildings at Homewood, the site recently donated to it. The problem of transferring the university from the city to its new site is one of considerable difficulty, but it is being studied carefully.

WORCESTER POLYTECHNIC INSTITUTE—The board of trustees of the Worcester Polytechnic Institute, Worcester, Mass., has decided to proceed immediately with the erection of a large building, which will be used exclusively for the purpose of an electrical engineering laboratory. An important feature which will be kept in mind in connection with the new building will be a laboratory for the use of the department of electric railway engineering, established last fall. The quarters now occupied by the electrical engineering department will be placed at the disposal of the departments of physics and of chemistry.

PERSONAL MENTION.

MR. R. A. WHITE, formerly auditor of disbursements of the New York Central & Hudson River Railroad Company, has been appointed auditor of the company in place of Mr. Marshall L. Bacon, deceased.

MR. W. H. McKINLOCK, of Chicago, president of the Metropolitan Electric Company, is visiting in New York this week renewing a host of old acquaintances. Mr. McKinlock's successful company represents a number of eastern manufacturers.

MR. WILLIAM B. WOODBURY, assistant general manager of the Cuyahoga Telephone Company, Cleveland, Ohio, has resigned. Mr. Woodbury will go to Detroit, Mich., for the Koehler-Brailey Telephone Syndicate, which owns the Kansas City independent telephone system. The syndicate has bought the Co-operative Telephone Company, of Detroit. Mr. Woodbury's work at Cleveland for the Cuyahoga Telephone Company has been very much appreciated and was especially commended in the recent report of the president to the stockholders.

MR. JAMES A. MILNE.

MR. JAMES A. MILNE, for a number of years controller of the Allis-Chalmers Company, Milwaukee, Wis., has accepted the position of general manager of Allis-Chalmers-Bullock, Limited, Montreal, Canada. This appointment becomes effective on or before May 1, 1906. Mr. Milne was born at Waterdown, Ontario, in 1872. After completing a public school and collegiate course he began his business career in Toronto in 1888. He held many responsible positions in business departments of various organizations, and in August, 1901, became chief cost clerk with the Allis-Chalmers Company. One month later he was appointed acting controller, being formally elected to that position at a meeting of the board of directors in May, 1902. Since the early part of last autumn Mr. Milne has been one of the directors of Allis-Chalmers-Bullock, Limited.

MR. HERMAN T. HOCHAUSEN has purchased and assumed active management of the Brooklyn Electrical Supply Company, Brooklyn, N. Y. Mr. Hochausen has resigned as president and general manager of the Metropolitan Engineering Company, of Brooklyn, disposing of his interest and participation in all other electrical enterprises. He will now devote his entire time to the advancement of the Brooklyn Electrical Supply Company. Mr. Hochausen is very well known throughout the electrical field; his father, Mr. William Hochausen, being the inventor of the "Excelsior" system of arc lighting, and electrical engineer of the Excelsior Electric Company, of Brooklyn. Mr. Herman T. Hochausen, after receiving a thorough technical education at the Polytechnic Institute, Brooklyn, obtained a minor position with the Excelsior Electric Company, becoming superintendent of construction and traveling expert. When the Excelsior company was taken over by the General Electric Company, Mr. Hochausen spent two years in the practice of marine and electrical engineering. Realizing the business possibilities of electric signs he devoted considerable attention to the development of this branch of the industry, and started the manufacture of signs under the firm name of H. T. Hochausen. Mr. Hochausen was one of the first to manufacture and place in service a wholly metallic sign. He afterward merged his sign business with the Metropolitan Engineering Company, becoming president and general manager of that company.

OBITUARY NOTICE.

MR. O. E. MADDEN died suddenly on Tuesday morning, February 13, at the age of sixty years, at his home in South Nyack, N. Y., from stomach trouble. Mr. Madden was for a number of years assistant general manager of the American Bell Telephone Company and was quite active in developing telephone interests in the pioneer days of that invention. Afterward he was in the electrical supply business in New York city and more recently was president of the Knollwood Cemetery Company, of Boston, Mass., making his headquarters at 20 Broad street, New York city. The funeral services were held on Friday, February 16, at his late residence.

ELECTRICAL SECURITIES.

What appears to be a rather general reaction of the unprecedented long upward swing of prices was in full force last week. The market has been gradually growing more inactive for some time and unless there is some decidedly new development there appears to be no hope of a stimulus until well into the spring. The talk concerning the coal strike has been more or less exaggerated, as this will not take place for a month at least; and, as a matter of fact, no one can yet say positively whether or not there will be a suspension of operations in the coal fields. Notwithstanding the dropping away of speculation and the general inactivity, a survey of the prices current shows that the gains made for the week practically balanced the losses. A feature of speculation for some time has been the tremendous appreciation in the value of copper and other smelting industries. A slight reaction in copper has brought prices about one cent per pound below December's level. This is as it should be, however, as in many quarters it is felt that the price of copper was a little higher than the condition of the trade demanded. It is paradoxical that the falling off in security prices has no reflection in industrial conditions in general. Reports from all quarters indicate that there is still ample hope that the spring will be a prosperous one, and that a good working summer is in store for all classes of industry.

ELECTRICAL SECURITIES FOR THE WEEK ENDING FEBRUARY 10.

New York:	*Closing.*
Brooklyn Rapid Transit	85
Consolidated Gas	177
General Electric	175
Interborough Rapid Transit	232
Kings County Electric (ex rights)	170
Manhattan Elevated	160½
Metropolitan Street Railway	120¼
New York & New Jersey Telephone	155
Westinghouse Manufacturing Company	185

It is estimated by a representative of the General Electric Company that the business of the corporation for 1906 will show an increase of 40 per cent over 1904. This would bring the amount of business billed for the year in excess of $50,000,000. The company paid dividends of 3 per cent in 1899, 6½ per cent in 1900, 9 per cent in 1901 and 8 per cent since then.

Boston:	*Closing.*
American Telephone and Telegraph	142
Edison Electric Illuminating	245
Massachusetts Electric	67
New England Telephone	136
Western Telephone and Telegraph preferred	92
Philadelphia:	*Closing.*
Electric Company of America	11¾
Electric Storage Battery common	81
Electric Storage Battery preferred	81
Philadelphia Electric	8¼
Philadelphia Rapid Transit	32⅝
United Gas Improvement	98
Chicago:	*Closing.*
Chicago Telephone	137½
Chicago Edison Light	163
Metropolitan Elevated preferred	69½
National Carbon common	82½
National Carbon preferred	118
Union Traction common	11½
Union Traction preferred	40

NEW PUBLICATION.

THE REPORT OF THE TENTH INTERNATIONAL ASSOCIATION OF NAVIGATION CONGRESSES, AT MILAN—The report of the tenth convention, at Milan, Italy, 1905, of the Permanent International Association of Navigation Congresses has been presented by St. John Clark, civil engineer, chief engineer of the Long Island Railroad, and Leon Gerard, electrical engineer, and past-president of the Belgian Society of Electricians, covering an economic and technical study of the mechanical traction of boats on rivers, canals and lakes. In connection with this there has recently been reprinted by M. Gerard an article on "The Electric Hauling of Boats," taken from the Bulletin de la Société Belge d'Electriciens.

INDUSTRIAL ITEMS.

THE METROPOLITAN ENGINEERING COMPANY, 27 Sixth avenue, Brooklyn, N. Y., is publishing a bulletin illustrative and descriptive of its electric sign installations.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has ready for distribution its 1906 catalogue descriptive of "Trojan" and Emerson fan motors.

THE AUDIT COMPANY OF NEW YORK has published a calendar for the year, the decoration being in the form of an intaglio copper plate with an allegorical frieze entitled "Liberty, Fraternity and Equality."

THE DIEHL MANUFACTURING COMPANY, Elizabethport, N. J., has ready for distribution its catalogue No. 17, descriptive and illustrative of ceiling, electrolier, column, telephone booth, counter column and desk fans.

THE VARLEY DUPLEX MAGNET COMPANY, Providence, R. I., announces that the American Electrical Works has discontinued the manufacture of the Varley company's patented windings. The Acme Wire Company, of New Haven, Ct., is the new licensee.

THE AMERICAN CAR AND FOUNDRY COMPANY has purchased for its works at Manchester, England, 100 tools, consisting of "Boyer" hammers and drills, from the Consolidated Pneumatic Tool Company, London, England, which is a foreign branch of the Chicago Pneumatic Tool Company, Chicago, Ill.

THE D. VAN NOSTRAND COMPANY, 23 Murray street, New York city, is distributing its monthly record of scientific books. The company is the publisher and importer of scientific, military and naval books. The monthly record contains a list of new books of interest to students and workers in the various departments of science.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., announces that it has filed papers in a suit against the Universal Storage Battery Company, manufacturer of the "Morrison" battery, alleging infringement in the construction of the "Universal" plate, the Knowles patent, owned by the Electric Storage Battery Company.

THE MISSOURI AMERICAN ELECTRIC COMPANY, 3327 Locust street, St. Louis, Mo., manufacturer of the Miller patent incandescent lamp, the McDonnell patent current controller, the McDonnell patent electric bell-ringing device and the McDonnell patent electric sign flasher, has issued a new catalogue descriptive of these specialties. This catalogue will be sent upon request to any one interested.

THE AITON MACHINE COMPANY, 126 Liberty street, New York city, has issued bulletin No. 2, describing the eight-drum stranding machine. This machine carries spools twelve inches by eight inches, at a speed of 200 revolutions per minute. The entire machine is mounted on a stiff bed-plate, and is equipped throughout with cut gearing. Complete details will be given upon request to the company.

THE R. M. CORNWELL COMPANY, Syracuse, N. Y., will be pleased to send its catalogue descriptive of the "Wonder" gasoline motors for stationary and marine service, from one and one-half horse-power up to six horse-power. The company furnishes complete outfits for every purpose. The new catalogue describes a number of typical applications, and the text is supplemented by a number of illustrations.

THE MASSEY MACHINE COMPANY, Watertown, N. Y., will be pleased to send its catalogue descriptive of the "ring turret" lathe. The turret is a solid ring encircling the bed, revolving on an annular base with forty-five-degree ways fifteen inches in diameter. One of these ways is adjustable. Play caused by either lifting or side stresses under heavy cuts or by leverage between the locking pin and a small centre bolt is eliminated, ensuring a solid tool setting. These lathes embrace, in addition to this important feature, a number of other characteristics, all of which are described in the bulletin.

THE ELECTRIC GOODS MANUFACTURING COMPANY, Boston, Mass., is the title under which the business of the Electric Gas Lighting Company will be carried on hereafter. There will be no change made in the policy or personnel of the company. The old name at one time indicated the nature of the business of the company, but it no longer describes the variety and extensive lines now manufactured and carried in its large jobbing business.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., is distributing a series of fliers and bulletins descriptive of some new and standard electrical apparatus. Among these are descriptions of household electric devices, type R switchboard instruments, a blotter showing a reproduction of a voltmeter record made by the new curve-drawing voltmeter type C, bulletin No. 4430, describing and illustrating variable-speed motors, and bulletin No. 4428, descriptive of arc-lighting apparatus.

THE GOULD STORAGE BATTERY COMPANY, New York city, is distributing a second edition of its September bulletin, descriptive of the regulating battery in connection with combined railway and lighting plants. This describes the apparatus installed by the Gould company for the Edison Electric Illuminating Company, of Topeka, Kan. The installation consists of 280 elements, type S-617, each having a capacity of 640 amperes for one hour, and a booster set which controls the operation of the battery, so that the generator load does not vary, even under the extreme conditions, more than two and one-half per cent from any mean value for which the booster may be adjusted.

THE JOHN A. ROEBLING'S SONS COMPANY, Trenton, N. J., has published a handsome catalogue dealing with the splicing of wire rope, giving an illustrated description of the methods in vogue. The primary object of the volume is to present a description of the method of wire rope splicing employed in the shops of the John A. Roebling's Sons Company. The illustrations are from photographs taken during the splicing of a one-inch diameter regular lay rope with six strands and a hemp centre. Illustrations are given of the various tolls necessary, and the work is carefully laid out in a series of logical illustrations and instructions from the beginning of the splice to the end.

THE H. W. JOHNS-MANVILLE COMPANY, 100 William street, New York city, held the annual convention of its branch managers and salesmen in New York city during the week of January 29. About 150 representatives were present. After a most interesting session, lasting four days, the convention wound up with a farewell dinner at the New York Athletic Club, Friday evening, February 2. The company is the well-known manufacturer of asbestos and magnesia products and electrical materials. Branch houses and representatives are established in various large cities throughout the country. The cities represented by attendants at this last convention are Milwaukee, Chicago, Boston, Philadelphia, St. Louis, Pittsburg, Cleveland, San Francisco, Los Angeles, Seattle, Kansas City, Minneapolis, Little Rock and New Orleans.

NEW MANUFACTURING AND CONSTRUCTING COMPANIES.

PORTSMOUTH, OHIO—The Knox-Dickey Telephone Manufacturing Company has been organized by L. D. York, F. H. Dickey, G. W. and W. F. Zottman. The capital is $10,000.

TRENTON, N. J.—The Lexington & Interurban Railway Company. To purchase and construct railways. $40,000. Incorporators: John A. MacPeak, F. R. Hansell and George H. B. Martin.

LOS ANGELES, CAL.—The Electrical Supply and Fixture Company, of Long Beach, has been incorporated with a capital of $25,000. The directors are E. A. Wilson, Santa Monica; A. A. Towne and George L. Curtis, of Long Beach.

BUFFALO, N. Y.—The Gail-Webb Manufacturing Company has been incorporated to manufacture telephone apparatus, etc. The capital stock is $25,000, and the incorporators are Harry M. Gail, of Buffalo; John W. S. Webb, Charles W. Webb, of Cleveland, Ohio.